# FOCUSED FEASIBILITY STUDY REPORT
# OPERABLE UNIT 1

## Kerr-McGee Chemical Corp.—Columbus Superfund Site
## 2300 14th Avenue North
## Columbus, Lowndes County, Mississippi
## EPA ID#MSD990866329

*Prepared for*

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August 9, 2018

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 95UCL | 95th upper confidence limit of the mean |
| AOC | area of concern |
| ARAR | applicable or relevant and appropriate requirement |
| BERA | baseline ecological risk assessment |
| bgs | below ground surface |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CFR | Code of Federal Regulations |
| COC | chemical of concern |
| COPC | chemical of potential concern |
| COPEC | chemicals of potential ecological concern |
| DNAPL | dense, nonaqueous-phase liquid |
| ELCR | excess lifetime cancer risk |
| EPA | U.S. Environmental Protection Agency |
| EPC | exposure point concentration |
| ESBTU | equilibrium partitioning sediment benchmark toxic unit |
| FFS | focused feasibility study |
| GRA | general response action |
| HHRA | human health risk assessment |
| HSWA | Hazardous and Solid Waste Amendments |
| Integral | Integral Consulting Inc. |
| KMCC | Kerr-McGee Chemical Corporation |
| LOAEL | lowest-observed-adverse-effects level |
| MDEQ | Mississippi Department of Environmental Quality |
| Multistate Trust | Greenfield Environmental Multistate Trust LLC |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NOAEL | no-observed-adverse-effects level |
| NPL | National Priorities List |
| NPW | net present worth |

| | |
|---|---|
| O&M | operation and maintenance |
| OU-1, -2 | Operable Unit 1, 2 |
| PAH | polycyclic aromatic hydrocarbon |
| PCP | pentachlorophenol |
| RAL | removal action level |
| Ramboll Environ | Ramboll Environ US Corporation |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| RFI | RCRA facility investigation |
| RI | remedial investigation |
| RME | reasonable maximum exposure |
| ROI | receptor of interest |
| RSL | Regional Screening Level |
| RTPO | remediation technology and process option |
| Site | Kerr-McGee Chemical Corp.—Columbus Superfund site |
| SPLP | synthetic precipitation leaching procedure |
| SWMU | solid waste management unit |
| TCLP | toxicity characteristic leaching procedure |
| TEQdf | toxicity equivalent concentrations of dioxins and furans |
| TOC | total organic carbon |
| Tronox | Tronox, LLC |
| TRV | toxicity reference value |
| USC | United States Code |
| UTL | upper tolerance limit |

# EXECUTIVE SUMMARY

Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust (Multistate Trust), has prepared this Focused Feasibility Study (FFS) report for Operable Unit 1 (OU-1) of the former Kerr-McGee Chemical Corporation Columbus, Mississippi, facility (the Site). The Site consists of two primary areas: the Former Plant Area and the Pine Yard. This FFS addresses OU-1, which includes Pine Yard surface soils (0 to 2 ft below ground surface [bgs]) and subsurface soils above the groundwater table (2 to approximately 8 ft bgs) with chemicals of concern (COCs) at concentrations that pose an unacceptable risk to human health, but do not represent an ongoing source of COCs to groundwater. Pine Yard soils that represent a primary source of contaminants to groundwater include soils below the groundwater water table that have been impacted by dense, nonaqueous-phase liquid. These soils, and the unsaturated zone soils that overlie them, will be addressed as part of the OU-2 feasibility study.

The objective of the FFS is to document the remedy selection process conducted pursuant to the Comprehensive Environmental Response, Compensation and Liability Act and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300).

The human health risk assessment (HHRA; Integral 2018a), which was conditionally approved on June 20, 2018, found that the primary source of human health risk is surface soils within the areas of the Pine Yard formerly used for wood storage. The findings from the HHRA form the basis for establishing the remedial action objectives for OU-1 soils, such that appropriate remedial alternatives can be developed and evaluated.

The draft baseline ecological risk assessment (BERA; Ramboll Environ 2017) found that the wooded and wetland areas of the Pine Yard, predominantly in the northern side of the Pine Yard, provide potentially suitable habitat for ecological receptors, such as insectivorous birds and mammals. Finalization of the BERA is pending resolution of comments provided by the U.S. Environmental Protection Agency (EPA) on May 23, 2018. Based on the data available at the time that the draft BERA was prepared, significant risks could not be ruled out for insectivorous birds and mammals potentially exposed to contaminants in surface soils in the wooded portions of the Pine Yard. These risks are primarily driven by areas of elevated surface soil concentrations in the same areas of the northern Pine Yard where human health risks are present and subject to the OU-1 remedial action. Implementation of any of the active remedies considered in this FFS and subsequent development of the Pine Yard are expected to achieve acceptable residual risks for terrestrial receptors in areas with suitable habitat in the Pine Yard. The need for additional remedial action will be evaluated as part of the OU-2 feasibility study if the final BERA concludes that unacceptable ecological risks exist and are not addressed by the OU-1 remedial action.

General response actions (GRAs) and remedial technologies and process options (RTPOs) evaluated in the FFS are summarized in the table below. The RTPOs identified for OU-1 soils were evaluated to identify those that are most viable to the site-specific conditions. Each RTPO was screened based on effectiveness, implementability, and relative cost to identify the RTPOs to be considered in the development of remedial alternatives. RTPOs shown in bold in the table below were retained for consideration in remedial alternatives development.

| General Response Action | Description | Remedial Technology and Process Options |
|---|---|---|
| Containment/Isolation | Engineered barriers that prevent/limit contaminant migration and receptor from contacting contamination, and/or prevent clean media from becoming contaminated. | **Cap/Cover** |
| Removal | Removal of contaminated media from its original location. | **Excavation** |
| Treatment | Use of *in situ* or *ex situ* technologies to chemically degrade and/or physically stabilize contaminants. | *In Situ* Stabilization<br>*Ex Situ* Stabilization<br>*In Situ* Chemical Amendment<br>Land Farming<br>Soil Washing |
| Consolidation and Disposal | Placement of contaminated media in a new, controlled location that eliminates potential exposure pathways between receptors and contaminated media. | **Landfill Disposal**<br>**Onsite Consolidation** |

Four remedial alternatives were identified for OU-1 soils:

- Alternative 1: No Action—No action is a baseline GRA scenario for the evaluation of alternative GRAs. No remedial action or monitoring would be performed under the no action GRA—providing a baseline assessment of the impact of the "as is" condition on potential receptors.
- Alternative 2: Removal and Offsite Disposal—This alternative includes the following main elements: excavation of contaminated OU-1 soils, disposal of excavated contaminated soils, and placement of clean backfill.
- Alternative 3: Removal and Onsite Consolidation—This alternative includes the following main elements: excavation of contaminated OU-1 soils, consolidation of excavated contaminated soils in the Former Plant Area, and placement of clean backfill.

- Alternative 4: Cover—This alternative includes the following main elements: placement of a 2-ft thick soil cover over contaminated OU-1 soils and implementation of institutional controls to prevent exposure to contaminants in soils beneath the soil cover.

Each alternative was evaluated according to the remedy evaluation criteria specified by EPA and the NCP. Each alternative must meet two threshold criteria—overall protection of human health and the environment, and compliance with applicable or relevant and appropriate requirements (ARARs)—to be eligible for selection as EPA's preferred alternative. Five balancing criteria are then applied as a framework to assess tradeoffs among the long-term and short-term effectiveness; reduction in contaminant toxicity, mobility, or volume through treatment; implementability; and cost of each alternative. The final two criteria address state and community acceptance. These are considered modifying criteria and are assessed by EPA, subsequent to the feasibility study, based on consideration of state and public comment on EPA's proposed plan for remedial action.

The diagram below summarizes the results of the detailed evaluation of remedial alternatives presented in this FFS.

***LEGEND***

- ● Excellent
- ◕ Good
- ◒ Fair
- ◔ Poor
- ○ Very Poor

| | | **EVALUATION CRITERIA** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Threshold** | | **Balancing** | | | | | **Modifying** | |
| | | Protectiveness | Compliance with ARARs | Long-Term Effectiveness | Short-Term Effectiveness | Reduction of Toxicity, Mobility, or Volume | Implementability | Cost (millions) | Regulatory Acceptance | Community Acceptance |
| **Alternative 1** | No Action | ○ | ○ | ○ | ◒ | ○ | ● | 0.18 | ○ | ○ |
| **Alternative 2** | Removal and Offsite Disposal | ● | ● | ● | ◔ | ● | ● | 9.89 | ● | ● |
| **Alternative 3** | Removal and Onsite Consolidation | ● | ● | ◕ | ◔ | ◕ | ◕ | 6.47 | ◕ | ◒ |
| **Alternative 4** | Cover | ● | ● | ◕ | ● | ◒ | ● | 3.14 | ◕ | ◔ |

The no action alternative does not meet the threshold criteria and is thus not considered a viable alternative for OU-1 soils. Overall, Alternative 2 ranks the highest of the three remaining alternatives with respect to the balancing criteria and is anticipated to be most acceptable to EPA, Mississippi Department of Environmental Quality (MDEQ), and the community. However, Alternative 2 also carries the highest cost. Alternatives 3 and 4 would achieve the same level of protectiveness as Alternative 2 at a substantially lower cost. However, both alternatives would leave contamination onsite, either in a consolidation area in the Former Plant Area (Alternative 3) or in the Pine Yard (Alternative 4). As a result, relative to Alternative 2, Alternatives 3 and 4 have an overall lower ranking with respect to the balancing criteria and are anticipated to be less acceptable by the regulatory and community stakeholders.

EPA, in consultation with MDEQ, will select the OU-1 remedial alternative and present it in the proposed plan. EPA will consider input from the public during public meetings, and written comments on EPA's proposed plan. The final OU-1 remedial alternative will be documented in the record of decision.

# 1 INTRODUCTION

Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust (Multistate Trust) has prepared this Focused Feasibility Study (FFS) report for Operable Unit 1 (OU-1) of the former Kerr-McGee Chemical Corporation (KMCC) Columbus, Mississippi, facility (the Site, Figure 1-1). OU-1 includes Pine Yard surface soils (0 to 2 ft below ground surface [bgs]) and subsurface soils above the groundwater table (2 to approximately 8 ft bgs) with chemicals of concern (COCs) at concentrations that pose an unacceptable risk to human health, but do not represent an ongoing source of COCs to groundwater. OU-1 encompasses an estimated 14-acre area and includes approximately 55,000 cubic yards of potentially impacted soils (Figure 1-2).

OU-1 does not include the Former Plant Area and areas offsite of the KMCC Site (if any) determined to pose an unacceptable risk to potential human or ecological receptors. In addition, OU-1 does not include the following areas of the Pine Yard:

- The Remedial Investigation Report (EarthCon 2018) identified an approximately 3-acre area along the western boundary of Pine Yard where soils below the groundwater water table have been impacted by dense, nonaqueous-phase liquid (DNAPL). These soils represent the primary ongoing source of COCs to groundwater in the Pine Yard. The soils within this "DNAPL Source Area," and the unsaturated zone soils that overlie them, will be addressed as part of the OU-2 feasibility study.

- OU-1 does not include the wetlands in the northern portion of the Pine Yard. The draft baseline ecological risk assessment (BERA; Ramboll Environ 2017) found that there is potentially suitable habitat in the wooded area and wetlands in the northern portion of the Pine Yard. The OU-1 remedial action is anticipated to address risks to terrestrial receptors in the northern Pine Yard. Ecological risk conclusions with respect to the wetlands are pending resolution of comments to the draft BERA provided by the U.S. Environmental Protection Agency (EPA) on May 23, 2018, and will provide the basis for evaluating the need for any additional remedial action in this area as part of OU-2.

## 1.1 PURPOSE AND ORGANIZATION

The Site consists of two areas, separated by 14th Avenue North: the Former Plant Area and the Pine Yard. This FFS addresses OU-1, which consists of unsaturated soils in the Pine Yard that do not represent a primary source of contaminants to groundwater. Pine Yard soils that represent a primary source of contaminants to groundwater are soils below the groundwater water table that have been impacted by creosote, present as DNAPL. These soils will be addressed under the OU-2 feasibility study. The estimated lateral and vertical extents of OU-1 soils have been estimated based on data collected and observations made during the remedial investigation.

This FFS identifies remedial action objectives (RAOs) for OU-1 soils contaminated by historical activities in the Pine Yard and develops and evaluates remedial alternatives to mitigate risks posed to human health and the environment as a result of that contamination. The objective of the FFS is to document the remedy selection process conducted pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300). The FFS follows U.S. Environmental Protection Agency (EPA) guidance provided in the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Interim Final)* (USEPA 1988a).

The FFS report is organized as follows:

- Section 1: Introduction—Purpose and Organization of the FFS Report, Site Description, Site History, Current and Reasonably Anticipated Future Land Use, Nature and Extent of Contamination, Contaminant Fate and Transport and Baseline Risk Assessment
- Section 2: Identification and Screening of Technologies—Remedial Action Objectives, General Response Actions, and Identification and Screening of Remediation Technologies and Process Options
- Section 3: Development and Screening of Remedial Alternatives—Evaluation Criteria and Description and Evaluation of Remedial Alternatives
- Section 4: Comparative Analysis of Remedial Alternatives
- Section 5: References
- Appendix A. Summary of Previous Site Investigations and Removal Actions
- Appendix B: Detailed Cost Estimate for Remedial Alternatives
- Appendix C: Risk Characterization Summaries for the Human Health Risk Assessment.
- Appendix D: Proposed Remediation Waste Designation Approach for Kerr-McGee Chemical Corp. Superfund Site—Columbus, MS

## 1.2 BACKGROUND INFORMATION

This section presents a summary of site background information, including a description of the Site and its history, current and reasonably anticipated future land use, the nature and extent of contamination, contaminant fate and transport pathways, and findings of the baseline risk assessments.

### 1.2.1 Site Description

The Kerr-McGee Chemical Corp. Superfund Site (EPA ID#MSD990866329) is located at 2300 14th Avenue North in Columbus, Lowndes County, Mississippi. The Site was an industrial wood treating facility operated by KMCC and its predecessors/successors from 1928 to 2003. Tronox, LLC (Tronox), a successor to KMCC, was the sole potentially responsible party. Pursuant to a 2011 Consent Decree and Environmental Settlement Agreement, the Multistate Trust is responsible for implementing all environmental actions at the Site consistent with its obligations to the beneficiaries of the Multistate Trust, EPA and Mississippi Department of Environmental Quality (MDEQ).

The Site covers approximately 90 acres and is generally bounded by 14th Avenue North to the north, Moss Street and a railroad right-of-way to the east, Tuffy Lane to the south, and 21st Street North and 22nd Street North to the west, and the Pine Yard (Figure 1-1). The KMCC facility is closed and all structures on the property have been demolished or dismantled. Access to the Site is restricted by a fence that encloses the entire property.

This FFS addresses OU-1 (Figure 1-2), which consists of soils in the Pine Yard that do not represent a primary source of contaminants to groundwater. The Pine Yard is approximately 44 acres of land bounded by U.S. Highway 82 to the north, by the railroad rights-of-way to the east, by 14th Avenue North to the south, and by private properties to the west (Figure 1-2). The Pine Yard was used primarily for lumber and scrap metal storage and had few, if any, above or below ground structures. The Pine Yard is currently vacant and much of the northern end is wooded.

The Pine Yard is relatively flat. Much of the stormwater infiltrates into the ground surface, although some of the stormwater from areas at the perimeter of the Pine Yard runs off via sheet flow into surrounding City of Columbus drainage ditches and, ultimately, to Luxapalila Creek (Figures 1-1 and 1-2). The City of Columbus storm drainage system brings a significant volume of stormwater from areas located to the north of the Site under Highway 82 in a culvert and through and around the Pine Yard in a series of storm drainage ditches. The City's ditches collect additional stormwater from an area north of 14th Avenue North, bounded on the west by the Brick Yard industrial area and North 20th Street and on the east by the railroad tracks east of the Pine Yard. South of 14th Avenue North, the drainage basin includes the east half of the Former Plant Area.

Drainage features at the Pine Yard include a man-made ditch with a southerly-to-easterly flow through the wetlands in the northern part of the Pine Yard. The City of Columbus storm drainage system brings water into this ditch on the north end of the Pine Yard, and the ditch exits the east side of the Pine Yard through a culvert located approximately 1,400 ft north of 14th Avenue North. Another City of Columbus storm drainage ditch flows south along the north half of the western Pine Yard property boundary before turning to the southwest, and then south, through the neighborhood located to the west of the Pine Yard, toward 14th Avenue North. Another shallow drainage swale is located along the west property boundary in the southern half of the Pine Yard. The northern half of this drainage swale flows to the north, and the southern half of the drainage swale flows to the south.

As shown in Figure 1-2, approximately 6.5 acres of the southern end of the Pine Yard and 4 acres of OU-1 lie within the 100-year floodplain.

The U.S. Fish and Wildlife Service National Wetlands Inventory "Wetlands Mapper" version 2 identifies a 5.66-acre area in the northeastern portion of the Pine Yard as a freshwater forested/shrub wetland. As part of the remedial investigation, Headwaters Inc. completed a survey to delineate the wetland boundaries in the Pine Yard. The Headwaters Inc. survey (2017) indicates that the northern portion of the Pine Yard contains a forested wetland and a forested upland with a man-made drainage ditch (which receives offsite stormwater drainage from the City of Columbus storm drainage system) (Figure 1-2). The survey determined that 9.10 acres is forested wetland.

The Pine Yard is underlain by two primary water-bearing units, the alluvial aquifer and the Eutaw formation. The shallowest water-bearing unit is the alluvial aquifer, an unconfined unit of unconsolidated alluvial sediment, consisting of a downward-coarsening sequence of interbedded clay, silt, sand, and gravel, to a depth of approximately 15 ft bgs (Figure 1-3). Groundwater in the alluvial aquifer is typically encountered at a depth of 8 ft bgs within OU-1, although perched groundwater can be encountered at depths as shallow as 2 ft bgs following heavy rainfall.

### 1.2.2 Site History

The following presents a summary of the history of the Site based on information presented in the Remedial Investigation (RI) Report (EarthCon 2018). This summary is based on documentation that was provided to the Multistate Trust by Tronox. The Multistate Trust never operated the site and therefore has no direct knowledge of historical operations.

#### 1.2.2.1 Operational History

The wood treating facility was originally developed and operated by T.J. Moss Tie Company. Construction of the plant began on August 15, 1928, and the plant was completed in February 1929. KMCC acquired the Site in 1963 and continued wood treating operations until the facility was closed in 2003. Manufactured products included railroad wooden cross ties, switch ties, and preserved timbers. Preservatives used in the operation were primarily creosote, creosote coal tar solutions, and pentachlorophenol (PCP).

During wood treating operations, green lumber was received and sorted at the plant, and was later seasoned, either by natural air drying, which required the wood to be stacked in a drying yard for up to 12 months, or by artificial seasoning using the Boulton process. Wood that was allowed to dry naturally was stored in the green tie storage areas and in the Pine Yard. The Boulton drying process involved subjecting the green lumber to heated creosote under a vacuum, which boiled the sap water out of the wood. After seasoning, the wood was then pressure-treated in a cylinder, or retort. The pressure treating process involved filling a cylinder with a treating solution (e.g., creosote or PCP) and applying pressure to force the treating solution into the wood.

After treatment, the wood was placed on a drip track for drying, and excess preservative was allowed to drip onto bare soil (Kearney/Centaur 1988; Tetra Tech 2012). Treated lumber was supposed to remain on the drip track for 24 hours; and although former employees claimed that timbers were often taken on rail trams to the Pine Yard immediately after coming out of the retort, no documentation has been found to corroborate these anecdotal claims. Between 1992 and 1996, wood was stored throughout the facility, except for the northern portion of the Pine Yard.

In 2003, the volume of wood storage was significantly reduced, and by 2004, no wood storage or manufacturing activities were apparent at the Site in aerial photographs. Structures were visible onsite through at least 2007, but all above-grade structures, other than the current office and operation and maintenance (O&M) buildings, appeared to have been demolished by 2010.

Available documentation (including a December 13, 1995, letter from Mr. Stephen Ladner/Kerr-McGee to Mr. Bruce Ferguson/MDEQ) indicates that the Pine Yard was used primarily for lumber and scrap metal storage. Historical aerial photographs suggest that between 1952 and 1959, the southern portion of the Pine Yard was used for storage of untreated lumber and the northern portion was used for storage of mixed untreated/treated lumber. Some treated wood storage took place in the southern portion of the Pine Yard in later stages of the plant operation. Further anecdotal information from former employees, not corroborated by documentation, said that on several occasions, KMCC brought in new gravel and crushed rock to place over stained soils at the Site. The RI data (EarthCon 2018) suggest that some waste dumping and/or process fluid (e.g., creosote, PCP solutions) spills may have also occurred in localized areas of the Pine Yard.

#### 1.2.2.2 Site Investigations

Multiple investigations have been conducted at the Site dating back to the 1988 Resource and Conservation Recovery Act (RCRA) facility investigation (RFI); however, environmental characterization data were not collected in the Pine Yard until the RI Phase II investigation was initiated in 2016. Appendix A summarizes the site investigations and removal actions completed prior to the Phase II investigation.

The following table summarizes the characterization data that have been collected in the Pine Yard and adjacent properties during the Phase II RI.[1]

| Sample Type | Number of Locations/ Samples Collected |
|---|---|
| Test Trenching | 11 transects within the Pine Yard area<br>2 transects along east and west boundaries |
| TarGOST | 41 locations |
| Soil Samples | 127 locations |
| Groundwater Samples (2017 Event) | 49 locations sampled in the alluvial groundwater<br>7 locations sampled in the Eutaw groundwater |
| Drainage Ditch Samples | 6 locations |
| Surface Water Samples | 3 locations |

In addition, the Phase II RI included the following studies/surveys:

- A geophysical survey was conducted in the southern portion of the Pine Yard prior to intrusive investigation activities to identify any debris and structures (e.g., utilities, concrete footings) that could pose an obstacle to investigation and/or remedial actions.
- To inform the FFS and remedial design activities, subsurface soil and groundwater characteristic data were collected in the Pine Yard, including moisture content, grain size analyses, hydraulic conductivity, pH, oxidant demand, nitrate/nitrite, total organic carbon, and alkalinity.
- A mini-excavator was used to conduct shallow test trenching ("potholing") in portions of the Pine Yard to identify the presence and extent of shallow impacted material resulting from operations and buried waste material.
- A 24-hour aquifer test was conducted in the Pine Yard to evaluate groundwater drawdown extent at various pump rates and to collect data for potential dewatering during potential removal action(s).
- Soil samples representative of the buried waste material and contaminated soil/gravel encountered in the Pine Yard during the potholing activities were collected and

[1] The sample numbers provided include only the samples collected within the footprint of the Pine Yard and immediately adjacent properties through the RI, which was completed in 2017. The site characterization included extensive sampling of private and public properties in the vicinity of the Site. These data were considered in the RI Report (EarthCon 2018) and the Pine Yard conceptual site model.

subjected to the synthetic precipitation leaching procedure (SPLP) to evaluate potential leaching from soil/gravel to groundwater.

#### 1.2.2.3 Site Regulatory History

The following is a brief summary of the regulatory history of the Site:

- KMCC submitted a RCRA Part A permit application in 1981 that notified EPA of the presence of Solid Waste Management Units (SWMUs), including two hazardous waste (K001) surface impoundments (Kearney/Centaur 1988).
- In 1989, KMCC entered into a consent order with the Mississippi Commission on Environmental Quality that required completion of a groundwater assessment and submittal of an addendum to the previously submitted RCRA Part B Permit Application.
- A State of Mississippi Hazardous Waste Management Permit (Permit No.: HW-90-329-01) was issued to KMCC on September 11, 1990. The permit identified 15 SWMUs and areas of concern (AOCs) that required an RFI. The permit expired on September 11, 2000. The permit was renewed effective June 11, 2001, for a term of 10 years. The permit expired again on May 31, 2011, and was not reissued.
- EPA issued the Hazardous and Solid Waste Amendments (HSWA) portion of the RCRA permit to KMCC on August 1, 1995. The HSWA portion required the facility to investigate releases of hazardous waste or hazardous constituents and to take appropriate corrective action for such releases. The HSWA portion of the permit expired on August 1, 2005. KMCC submitted a letter to EPA dated April 1, 2005, requesting renewal of the HSWA portion of the RCRA permit. The permit was not reissued.
- Permit No. HW-90-329-01 was transferred to Tronox in 2005, and then to Greenfield Environmental Multistate Trust, LLC, not individually but solely in its representative capacity as Trustee of the Multistate Environmental Response Trust, in February 2011. As previously noted, this permit expired on May 31, 2011, and was not reissued.

EPA placed the Site on the Superfund Program's National Priorities List (NPL) in 2011. Tronox's environmental liabilities were resolved pursuant to a bankruptcy settlement approved by the Court in 2011 and the Multistate Trust was established. In addition, Anadarko Petroleum Corp. (a successor to KMCC) settled with the U.S. Department of Justice. The settlements provided funding for EPA and the Multistate Trust to continue conducting assessments and cleanup work at the Site. EPA is the lead regulatory agency for the Site, and MDEQ is the supporting agency. All O&M, compliance monitoring, and inspections of the closed surface impoundments and the groundwater extraction and treatment system are now subject to the applicable requirements of CERCLA.

#### 1.2.2.4 Completed and Ongoing Remedial Actions

The following summarizes the completed and ongoing remedial actions at the Site:

- 1986: Surface Impoundment Closure (Kearney/Centaur 1988)—Surface impoundments, identified as "Aeration Impoundment" and "Sedimentation Impoundment," were operated under Interim Status Standards until closure was completed in 1986. Closure consisted of removing all liquids, removing and recycling usable recovered product, removing and/or solidifying the remaining sludge, backfilling with soil from existing berms and clean soil, and constructing a RCRA cap over both impoundments.
- 1990 to Present: A groundwater extraction and treatment and DNAPL recovery system has been operational at the Former Plant Area since 1990.
- 2005: Ditch Sediment Removal (ERM 2005)—Interim measures were completed to remove sediment impacted by polycyclic aromatic hydrocarbons (PAHs) in the ditch system along the eastern Site boundary. Impacted soil in 1,850 linear feet of ditch was removed along the eastern side of the Former Plant and within two railroad rights-of-way. The interim measures addressed 1,850 linear feet of ditches in four areas (Areas 1–4). Area 1 was located on the southern side of 14th Avenue North near 22nd Street. Area 2 extended from the northeastern corner of the KMCC property and continued southerly for a distance of 255 ft to a point where the ditch flowed beneath railroad tracks. The portion beneath the railroad tracks was not excavated. The ditch excavation continued southerly along the eastern side of the railroad tracks and within the right-of-way for a distance of 750 ft to an intersection with another ditch (Area 4). The Area 4 ditch was also excavated as part of the interim measures.
- 2006–2007: Ditch Sediment Removal (Tronox 2010)—Impacted soil was discovered during a City of Columbus drainage improvement project that began at Propst Park, approximately 2,200 ft southeast of the Site at the eastern end of 7th Avenue North (Tronox 2010). The City requested that Tronox assess the nature and extent of the affected soils and implement remedial activities, if necessary. Based on the assessments conducted by Tronox, remedial activities were conducted in Propst Park between 7th Avenue and 5th Avenue, as well as approximately 130 ft of ditch at the eastern end of 7th Avenue. The section of the ditch downstream from 5th Avenue had reportedly been addressed in an earlier drainage project and the banks were lined with gabions and rip-rap. The report stated that creosote impact occurred in pockets of various sizes and shapes rather than as continuous deposits over the length of the remediation area. Impacted soil was excavated and disposed offsite. A total of 24 confirmation samples were collected and the ditch was backfilled. For 1 of the 24 confirmation samples, benzo[*a*]pyrene was found at a concentration exceeding the EPA Region 9 preliminary remediation goal of October 2004, with a residential target risk of $1\times10^{-4}$.

- 2010–2011: Hunt School Removal Action (Tetra Tech 2011)—Removal evaluations and actions were conducted by Tetra Tech on behalf of EPA from October 2010 to May 2011. Removal actions were conducted at Hunt Intermediate School, at a residential property at 1009 Moss Street, and at Maranatha Faith Center. The removal action at Hunt Intermediate School consisted of excavating a 50- by 50-ft area in the former football field to a depth of 1 ft bgs and removing approximately 100 tons of soil. The removal action at 1009 Moss Street was conducted in the northeastern portion of the property and extended to a depth of 1 ft over the majority of the excavation area, removing approximately 148.6 tons of soil. The action at Maranatha Faith Center involved removal of a soil pile containing approximately 30 tons. The soil from each location was transported to the Golden Triangle Subtitle D Landfill and disposed of as non-hazardous waste.
- 2014–2015: 14th Avenue Ditch Improvement Project (Tetra Tech 2015)—The Multistate Trust's contractor (Tetra Tech) performed the excavation necessary to construct the new 14th Avenue North ditch and provide a clean work area for the City of Columbus to construct a new concrete-lined drainage way. During excavation of the new ditch, which runs parallel to 14th Avenue North through the northerly portion of the Site, there was little visual evidence of soil contamination. Further, analytical results of samples of the excavated materials (which are currently stockpiled on the Site) showed that no site-related chemicals of potential concern (COPCs) were present at concentrations exceeding their respective residential Regional Screening Levels (RSLs). As part of the 14th Avenue North ditch project, Tetra Tech also removed contaminated sediment from the bottom of the old ditch and placed the spoils in a corner of the onsite stockpile, segregated from the soils excavated during construction of the new ditch. The environmental actions and the construction project were completed in 2015.
- 2016: Residential Yard Removal—Soil was removed from the backyard of the residential property located at 2614 17th Avenue North where benzo[*a*]pyrene concentrations were found to exceed the residential regional removal management levels[2] at that time. The soil removal encompassed an area of approximately 61 ft wide, 56 ft long, and 1 ft deep. A total of 126 cubic yards was removed and taken to the Golden Triangle Regional Landfill for disposal. The excavation was backfilled with clean soil and completed to grade with 4 in. of topsoil and sod.
- 2016: 7th Avenue North Storm Drainage Ditch Removal Action—The first removal action to address contaminated ditch sediments and soils was implemented along the north side of 7th Avenue North, between the Maranatha Faith Center and North 28th Street. This removal action involved excavating approximately 7,000 cubic yards of sediment

[2] EPA updated regional removal management levels in December 2017.

and soil in the main ditch along 7th Avenue. A total of 2,640 cubic yards was transported to the Golden Triangle Regional Landfill for disposal. After contaminated sediment was removed, a box culvert was installed to return the ditch to service.

- 2017 to Present: Voluntary Removal Action in the Pine Yard—The Multistate Trust initiated field activities associated with site preparation in anticipation of the OU-1 remedial action. Based on discussions with EPA and MDEQ, it is anticipated that excavation of contaminated soils will be the preferred remedial action. The removal action may be completed as a voluntary removal action to expedite the availability of the Pine Yard for redevelopment in consultation with EPA and MDEQ. All remedial actions are being conducted per work plans approved by EPA (EarthCon 2017a; Integral 2018b).

### 1.2.3 Current and Reasonably Anticipated Future Land Use

The Pine Yard property is owned by the Multistate Trust and is zoned for mixed industrial/ commercial use. Upon completion of remedial actions, the Multistate Trust intends to make the Pine Yard available for community-supported redevelopment. Community outreach activities, market studies and evaluations of site conditions are being evaluated and will be documented in conceptual redevelopment plans, currently expected to be available in late-2018.

Based on discussions between the Multistate Trust, EPA, and MDEQ on April 24, 2018, it was determined that, for the purpose of this OU-1 FFS, a portion of the Pine Yard adjacent to the western property boundary could reasonably be anticipated to have future residential development. This potential residential use area (Figure 1-2) is defined based on:

- Proximity to existing residential properties
- The average width of residential parcels west of the Pine Yard plus the width of a residential roadway
- Exclusion of any area within the 100-year floodplain.

There is no reasonably anticipated land use of the jurisdictional wetlands area and, due to lack of access, the small area of land in northeast corner of the Pine Yard that is bounded to the west and south by wetlands, to the east by the railways, and the north by Highway 82.

Pending completion of the redevelopment planning, the objective of the OU-1 FFS is to support the selection of a remedy that will achieve conditions that would be protective for residential use along the western portion of the Pine Yard and for industrial/commercial use in remaining developable areas. It is currently anticipated that redevelopment will occur in the western and southern portions of the Pine Yard, outside of the designated wetland boundary. Site development will also be subject to federal, state, and local regulations and standards governing development in floodplain settings.

### 1.2.4 Nature and Extent of Contamination

This section presents a summary of the nature and extent of contamination associated with OU-1 based on the data and analyses presented in the RI Report (EarthCon 2018). In addition, this section presents a summary of the findings of the baseline human health risk assessment (HHRA), which was submitted to EPA on April 4, 2018 (Integral 2018a) and conditionally approved on June 20, 2018, and the draft BERA (Ramboll Environ 2017), in relation to OU-1. While the focus of this section is on OU-1, a general description of the broader Pine Yard is included where necessary to provide context.

#### 1.2.4.1 Sources and Distribution of COCs in OU-1

Past operations in the Pine Yard included storage of treated and untreated wood, and some scrap metal storage. These activities are anticipated to have resulted in impacts to OU-1 soils across a large portion of the Pine Yard. In localized areas where larger releases appear to have taken place, impacts extend deeper into the unsaturated zone and, at times, to below the groundwater table. Table 1-1 summarizes the chemicals present in OU-1 soils at concentrations that represent a potential unacceptable risk to potential receptors under the anticipated future land use for the Pine Yard. The majority of COCs are associated with wood treating-related chemicals (primarily PAHs and PCP), although arsenic, chromium, carbazole, copper, dioxins/furans (measured as toxicity equivalent concentrations of dioxins and furans—TEQdf), and mercury have also been detected at levels that may pose a potential human health and/or ecological risk in several soil samples from OU-1.

PAHs, and benzo[*a*]pyrene in particular, are common urban contaminants and are frequently present along roadways and rail corridors. TEQdf is also a common urban contaminant frequently associated with combustion (e.g., aerial deposition associated with waste burning). Therefore, it is possible that some portion of the contamination in the Pine Yard is unrelated to past site activities. Most notably, a considerable volume of stormwater drains from Highway 82 and adjacent area, which may have been and continue to be a source of urban contaminants to the wetlands in the northeast end of the Pine Yard. Arsenic occurs naturally in soils from this region in Mississippi and was detected in background soil samples collected as part of the RI, typically at concentrations exceeding residential RSLs (EarthCon 2018). An upper tolerance limit (UTL)[3] concentration of 8.7 mg/kg was calculated for arsenic in background soils based on Site-specific data collected during the RI (Integral 2018b).

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[3] UTLs are commonly used to establish a background threshold value (USEPA 2013) and can be used to define a "not-to-exceed" value that can be used in establishing cleanup goals. A UTL is designed to contain, but not exceed, a large fraction (e.g., 95 percent) of the possible background concentrations, thus providing a reasonable upper limit on what is likely to be observed in background. A UTL for 95 percent coverage (i.e., 95/95 UTL) represents the value below which 95 percent of the population are expected to fall (with 95 percent confidence).

The majority of impacts to OU-1 soils are confined to the surface (0 to 2 ft bgs) and are associated with treated wood storage. This pattern of impacts to surficial soils near storage areas is common to wood treatment sites in general, but is also common for areas adjacent to highways and rail corridors. These impacts typically occur as contaminated soils and/or thin layers of creosote only a few inches thick. The creosote layers and associated COPCs are subject to weathering processes including photodegradation, volatilization, and oxidation, and typically form an asphalt-like layer. These materials tend to have lower COPC concentrations than fresh creosote because of the weathering process and have relatively low permeability. As a result, the COCs associated with these materials typically do not migrate, and the materials do not represent a significant source of COC leaching to groundwater. Pine Yard operations are known to have included periodically spreading layers of gravel over the soil surface, burying the layers of asphalt-like creosote. As a result, these creosote layers are often observed as thin lenses in surface soils, typically at depths of less than 2 ft bgs, although they have been observed at deeper depths in a few distinct areas of the Pine Yard. There are no principal threat wastes known to be present in OU-1 soils.

There are localized areas where greater amounts of residual creosote, sheen, and/or heavily-stained soils are observed in unsaturated zone soils within OU-1. These impacts often extend to several feet in depth and, in limited areas, to below the water table. OU-1 does not include the DNAPL Source Area where DNAPL is present below the water table and represents a persistent contaminant sources to groundwater. This area will be evaluated as part of the OU-2 feasibility study. The RI has identified an area along the eastern property boundary of the Pine Yard where soil impacts occur throughout much of the unsaturated zone, but do not appear to be extensively present below the water table. This area is included in OU-1.

The RI Report (EarthCon 2018) includes a detailed presentation of the distribution of contamination associated with the Site, including the Pine Yard.

#### 1.2.4.2 OU-1 Depth Zones

For the purpose of this OU-1 FFS, three depth-based zones of soil contamination have been defined:

- Zone 1—Debris and impacted material present on the ground surface. These materials were identified in six relatively small and localized areas within the Pine Yard.
- Zone 2—Impacted surface soils (0 to 2 ft bgs) most commonly associated with weathered creosote that is similar to asphalt, but also with localized areas where COC concentrations are present above health-based screening levels and/or debris is present.
- Zone 3—Soils in the unsaturated zone below Zone 2 (2 to approximately 8 ft bgs) where visible contamination is present.

Zone 1 was addressed under a voluntary action by the Multistate Trust. Figure 1-4 summarizes the extent of Zones 2 and 3 to be addressed under the OU-1 removal action, which encompasses the area and volumes summarized below.

| Zone | Area (acres) | Volume (cubic yards) |
|---|---|---|
| 2 | 13 | 41,513 |
| 3 | 1 | 13,497 |

The following summarizes key observations with respect to the distribution of contamination in Zones 2 and 3.

**Zone 2**

Zone 2 spans the depth interval of 0 to 2 ft bgs. The 0 to 2-ft increment, which was selected in consultation with EPA, with consideration to both the potential exposures and the available Pine Yard data, differs from EPA Region 4's default surface soil definition of 0 to 1 ft bgs (USEPA 2018). As discussed below, impacts are frequently observed in the top 2 ft of soils in areas where treated wood was stored. The inclusion of soils up to 2 ft allows for contact with soils that may be disturbed during activities such as gardening, outdoor maintenance, or landscaping accounted for in the HHRA.

Three data sets were considered in establishing the lateral extent of Zone 2:

- Historical Aerial Photographs: Historical aerial photographs were reviewed to evaluate the extent of the Pine Yard that was used for wood storage and related activities that potentially may have contributed to contamination of soils. This area represents an outer bound of the potential lateral extent of Zone 2 soils.
- Soil Sample Data: Chemical concentrations exceed one or more of the health-based screening levels in 75 of the 106 surface soil samples that have been collected from the Pine Yard. The majority of these exceedances occur within the footprint of historical activities evident in aerial photographs.
- Pothole Data: As part of the Phase II RI, a backhoe was used to dig potholes to a depth of 4 to 8 ft bgs on transects throughout the Pine Yard. Visual observation of the potholes revealed that thin, asphalt-like layers of creosote are present in surface soils in the northern and central portions of the Pine Yard, consistent with impacts from storage of treated wood and subsequent burial by gravel placed by plant operators. Additional pothole data collected in the southern portion of the Pine Yard during March 2018 confirmed that impacts to soils are generally less frequent in this area.

**Zone 3**

Zone 3 includes impacted soils in the unsaturated zone that extend from below Zone 2 (>2 ft bgs) to the groundwater table (typically 8 ft bgs). At this time, the only area of Zone 3 impacted soils has been identified along the eastern Pine Yard property boundary in the approximate north-to-south center of the Pine Yard (Figure 1-4), where pothole data and boring logs revealed the presence of impacted soils and debris at or near the ground surface and extending to near the groundwater table. Additional soils may be excavated from Zone 3 if visible contamination is present at the base of the Zone 2 excavation.

### 1.2.5 Contaminant Fate and Transport

COCs associated with OU-1 soils can be transported in the surface and subsurface environment through the mechanisms shown conceptually in Figure 1-5.

Particulate-bound COCs can potentially be mobilized from the soil surface through wind or water erosion. The topography of the Pine Yard is flat, and much of the soil at the ground surface has a large percentage of gravel. As a consequence, much of the rainfall to the Pine Yard infiltrates vertically into the soil—limiting the potential for transport with stormwater runoff. The presence of gravel also reduces the potential for wind-borne transport of dust from Pine Yard surface soils. Data collected during the RI indicate that these mechanisms have not resulted in substantial transport of COCs to adjacent properties or stormwater drainages (EarthCon 2018).

COCs in the unsaturated zone can also be mobilized to groundwater as a result of dissolution into, and downward transport with, infiltrating rainwater. The COCs in OU-1 soils are generally characterized by moderate-to-low solubility, low vapor pressure, and high partitioning coefficients (Table 1-2). As a result, the COCs partition strongly to soils (particularly to the organic content fraction of soils) and have relatively low mobility in the dissolved phase. Further, the potential for leaching of PAHs within the asphalt-like creosote materials in near-surface soils to underlying groundwater is limited because of the material's physical consistency (e.g., low permeability) and the relatively low PAH concentrations in these materials due to weathering. The low potential for COC migration from OU-1 soils to groundwater was confirmed by SPLP testing of buried waste material and creosote-contaminated soil/gravel encountered in the Pine Yard during the potholing activities. These tests resulted in SPLP leachate to total solids concentration ratios for PAHs and PCP that were typically less than 0.05 percent (EarthCon 2018). The RI concluded based on these factors that OU-1 soils are not an ongoing source of COPCs to groundwater.

Although the majority of COCs in OU-1 soils are characterized by low volatility, naphthalene is moderately volatile and can potentially volatilize from surface soils to the atmosphere. The potential transport by this mechanism is limited by the relatively low concentration of naphthalene in OU-1 soils.

### 1.2.6 Baseline Risk Assessment

This section presents a summary of the findings of the baseline HHRA and BERA that pertain to OU-1. The HHRA quantifies the risks posed to human receptors based on potential future land uses under current site conditions. The HHRA and BERA quantify potential unacceptable risk to human and ecological receptors and identify the contaminants and exposure pathways that need to be addressed by the remedial action to protect human health and the environment.

#### 1.2.6.1 Baseline Human Health Risk Assessment

The HHRA was submitted to EPA and MDEQ on April 4, 2018, and was conditionally approved on June 20, 2018. Potentially exposed populations evaluated are future residents, workers, and construction workers, and current and future trespassers. The following receptors and exposure pathways were quantitatively evaluated for the Pine Yard and are applicable to OU-1[4] (Figure 1-6):

- Residents (future)—incidental ingestion of surface soil[5], dermal contact with surface soil, and inhalation of particulates and volatile compounds in outdoor air.
- Outdoor workers (future)—incidental ingestion of surface soil, dermal contact with surface soil, and inhalation of particulates and volatile compounds in outdoor air.
- Indoor workers (future)—incidental ingestion of surface soil.
- Construction workers (future)—incidental ingestion of soil, dermal contact with soil, and inhalation of particulates and volatiles in outdoor air. (Exposure to the surface and subsurface soil increments were evaluated separately for construction workers.)
- Trespasser (current, future)—incidental ingestion of soil and dermal contact with surface soil.

The COPCs evaluated in the HHRA were selected by comparing maximum detected concentrations in soil to risk-based screening levels (inorganic and organic chemicals) and,

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[4] The comprehensive evaluation of human health risks including risks exposure to media in areas outside of OU-1 can be found in the HHRA report.

[5] A few of the samples included in the soil evaluations at the Pine Yard were characterized as sediment samples. These were treated together with soil samples because there was equal exposure potential to both soil and sediment by site receptors.

where available, background sample concentrations (inorganic chemicals only). Risks associated with the COPCs were quantified in the HHRA.

Exposures were quantified by estimating potential chemical intake (dose), associated with each potential exposure pathway. Exposure point concentrations (EPCs) were calculated and represent the chemical concentration that a receptor could contact over the exposure period. Exposure parameters that defined the frequency, duration, and magnitude of potential contact with soil were used to estimate dose under a reasonable maximum exposure (RME)[6] scenario. Cancer slope factors and inhalation unit risks were used to quantify the toxicity of carcinogens. Reference doses and reference concentrations were used to quantify noncancer toxicity.

The following table summarizes the excess lifetime cancer risks (ELCR) and noncancer hazard indices applicable for OU-1 by receptor group.

RME Excess Lifetime Cancer Risk and Noncancer Hazards

| Receptor | ELCR soil and outdoor air | Hazard Index soil and outdoor air [a] |
|---|---|---|
| Resident | $2 \times 10^{-3}$ | 100 |
| Outdoor Worker | $4 \times 10^{-4}$ | 9 |
| Indoor Worker | $2 \times 10^{-4}$ | 4 |
| Construction Worker (Surface) | $5 \times 10^{-5}$ | 30 |
| Construction Worker (Subsurface) | $2 \times 10^{-6}$ | 0.6 |
| Trespasser | $6 \times 10^{-5}$ | 4 |

Notes:
In line with EPA guidance (USEPA 1989 RAGS A), all ELCR and hazard indices are shown to one significant digit.
[a] Risks to child resident

COCs were identified in accordance with EPA Region 4 guidance for HHRA. Table 1-3 presents COCs by receptor group for the Pine Yard. Tables in Appendix C present summaries for receptors with an excess lifetime cancer risk above $1 \times 10^{-4}$ and noncancer hazard index above 1.

The primary drivers for risks associated with exposure to surface soil and particulates and volatile chemicals emitted from surface soil into outdoor air for both cancer and noncancer risk are TEQdf and benzo[*a*]pyrene. The findings of the HHRA indicate that there is no unacceptable risk to a construction worker exposed to subsurface soils in the Pine Yard. The HHRA

[6]The RME estimate is a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures.

concluded that there are no unacceptable risks for trespassers exposed exclusively to the wetland area within the Pine Yard.

#### 1.2.6.2 Baseline Ecological Risk Assessment

The BERA was prepared by Ramboll Environ US Corporation (Ramboll Environ) and submitted to EPA on July 14, 2017, as Appendix B to the draft RI Report (EarthCon 2017b). Finalization of the BERA is pending resolution of EPA comments received May 23, 2018. The summary presented herein is based on the findings of the 2017 draft BERA.

The BERA focused on two areas of the Site with suitable habitat quality to support ecological receptors: 1) the wooded area of the Pine Yard (including the wetlands) and 2) downgradient waterbodies (i.e., the Oxbow/Luxapalila Creek). The following are the key findings of the BERA for the Pine Yard specifically in relation to OU-1.

**Identification of Chemicals of Potential Ecological Concern**

Chemicals of potential ecological concern (COPECs) for the BERA were selected separately for each environmental medium (soil, sediment, and surface water) and exposure unit (Pine Yard and Oxbow/Luxapalila Creek). COPECs were identified from the detected chemicals in each environmental medium through a three-step process as follows:

- Screen out chemicals based on concentrations below screening values (maximum concentration and/or 95% upper confidence limit of the mean [95UCL]). Conservative effects-based ecological screening values relevant to each environmental medium were selected from sources as described in the BERA report (EarthCon 2017b) and compared to maximum detected concentrations and 95UCL values for each medium.
- Screen out chemicals where site concentrations are consistent with background.
- Screen out chemicals based on other considerations:
  - The chemical is a laboratory contaminant.
  - The chemical is present at low frequency of detection and low concentration and has no history of past or current use of the chemical at the Site.
  - The chemical is an essential nutrient.

Table 1-4 summarizes the selected COPECs for the Pine Yard exposure unit.

**Ecological Exposure Assessment**

Based on observations made during the ecological reconnaissance and in consultation with EPA, suitable quality ecological habitat in the Pine Yard is limited to the northern portion. At the time of the reconnaissance, the northern portion of the Pine Yard was vegetated with young trees, while the southern portion had sparse herbaceous vegetation. The northern portion provided potential habitat for passerines (i.e., songbirds) and small mammals that inhabit and/or forage in wooded or edge habitats, and those receptor groups were therefore the focus of the BERA. Because of its limited area, the northern portion of the Pine Yard was not expected to support carnivorous birds or mammals with extensive home ranges.

Since the time of the ecological reconnaissance, the trees have been removed from a large portion of the northern Pine Yard in preparation for the OU-1 remedial action—substantially reducing the area of suitable terrestrial habitat. As discussed in Section 1.2.3, the area of the Pine Yard west and south of the wetlands is expected to be developed for commercial/industrial use following remediation and a strip along the western boundary may be developed for residential use—including the wooded area of the northern end of the Pine Yard. Following development the commercial/industrial land use areas will no longer provide suitable ecological habitat. Similarly, developed portions of the residential land use area will not provide suitable ecological habitat, although undisturbed land within the residential land use area could potentially represent a marginal quality habitat following development.

The small wetland in the northern portion of the Pine Yard (Section 1.2.1) may provide some aquatic habitat on a small scale. The wetland is characterized by emergent vegetation and several large black willow (*Salix nigra*) trees. This habitat is not part of the OU-1 remedial action.

The following receptors of interest (ROIs) were evaluated in the BERA:

- Short-tailed shrew (*Blarina carolinensis*)—terrestrial invertivorous mammal
- American robin (*Turdus migratorius*)—terrestrial invertivorous bird
- Mallard (*Anas platyrhynchos*)—aquatic invertivorous bird
- Raccoon (*Procyon lotor*)—aquatic invertivorous mammal
- Benthic invertebrates in the wetland sediments.

Figure 1-7 presents a conceptual site model of the COPEC sources at the Site, migration pathways, ROIs, and their exposure pathways.

In consideration of potential effects on benthic invertebrates, relevant surface sediment chemistry data at each sampling station were evaluated individually. That is, each sediment sampling station was treated as a discrete exposure point. This practice reflects the relative immobility of benthic invertebrates and facilitates the spatial analysis of sediment exposures. Concentrations of PAHs in sediment were considered on an organic carbon-normalized basis (as µg/g OC). For purposes of assessing risks to invertebrates, dioxin and furan concentrations were assessed based on congener concentrations rather than TEQ. Invertebrates lack the aryl hydrocarbon receptor, which is critical to the "dioxin-like" mechanism of toxicity in vertebrates. The TEQ approach is specific to "dioxin-like" toxicity, and as such it is not applicable to invertebrate exposure assessment.

Wildlife ROIs were assumed to be exposed to COPECs via ingestion of diet, ingestion of drinking water, and incidental ingestion of soil and/or sediment while foraging or preening/grooming. For all applicable exposure media, exposure was modeled for mean and high-end exposure concentrations. For mean exposure concentrations, EPCs are represented by mean observed environmental media concentrations. For high-end exposure concentrations, EPCs were represented by 95UCLs. In both cases, EPCs were calculated using the Kaplan-Meier method for COPECs with nondetect results. ProUCL (USEPA 2013) was used for the Kaplan-Meier mean and 95UCL calculations. EPCs for abiotic media (e.g., sediment, surface water, and soil) were based on measured concentrations while EPCs for biotic media (e.g., terrestrial plants, terrestrial invertebrates, small mammals, aquatic plants, aquatic invertebrates, and fish) were calculated using bioaccumulation factors. Additional details on the selection of exposure parameters and assumptions to calculate the total daily intake are provided in Section 3.3 of the BERA (Ramboll Environ 2017). Some exposure parameters are being updated in response to EPA comments (e.g., ingestion rates); the effects of these changes on overall risk conclusions are not known at this time.

**Ecological Effects Assessment**

Benthic invertebrates were evaluated based on two measurement endpoints:

- Measured concentrations of COPECs in sediment in relation to appropriate sediment quality benchmarks and concentrations reported in the literature as protective of invertebrates (sediment chemistry)
- Measured concentrations of COPECs in surface water in relation to appropriate surface water benchmarks and concentrations reported in the literature as protective of aquatic life (water chemistry).

The measures of effects on invertebrates that were considered in this BERA are literature-derived toxicity reference values (TRVs), expressed as concentrations of COPECs in sediment and surface water below which adverse effects in invertebrates are not anticipated. An equilibrium partitioning sediment benchmark toxic unit (ESBTU) approach was used to evaluate effects of PAHs on benthic invertebrates to account for partitioning between sediment organic carbon and porewater and also to incorporate multiple PAHs with similar modes of toxicity. Additional details are provided in Section 4.1 of the BERA (Ramboll Environ 2017).

Birds were evaluated in the BERA based on one measurement endpoint:

- Comparison of modeled dietary intake of COPECs by two representative avian species (American robin and mallard) to doses reported in the literature as thresholds for adverse effects on survival or reproduction (bird hazard quotients).

Mammals were evaluated in the BERA based on one measurement endpoint:

- Comparison of modeled dietary intake of COPECs by two representative mammalian species (short-tailed shrew and raccoon) to doses reported in the literature as thresholds for adverse effects on survival or reproduction (mammal dose-based hazard quotients).

TRVs for wildlife receptors were initially derived for no-observed-adverse-effects level (NOAEL) daily dose concentrations as a conservative toxicity value for evaluating potential effects to reproduction and survival. Where NOAEL TRVs were exceeded, refinements to the wildlife effects assessment included consideration of dose-response analyses and lowest-observed-adverse-effects levels (LOAELs) in addition to NOAELs (e.g., the geometric mean of the NOAEL and LOAEL). Given the absence of threatened or endangered species at the site, LOAEL TRVs will be applied in the BERA and the sources of specific LOAELs may be modified in response to EPA comments. TRVs were derived from literature sources as described in Section 4.3 of the BERA (Ramboll Environ 2017).

**Ecological Risk Characterization**

Risk characterization involves the mathematical comparison of exposure and effects estimates. Hazard quotients are ratios that capture the relationship between potential exposure and toxicity. Hazard quotients less than 1 indicate that the calculated COPC exposure is below the toxicity benchmark, whereas those greater than 1 indicate that estimated exposure is greater than the toxicological benchmark and that further ecological evaluation may be necessary in order to more accurately characterize risks. The significance of a hazard quotient greater than 1 is partly dependent upon the toxicity benchmark used. It is unlikely, however, that a chemical with a hazard quotient less than 1 for a NOAEL benchmark will cause an adverse effect (USEPA 1997).

**Benthic Invertebrates**

The sediment chemistry measurement endpoint for benthic invertebrates in the Pine Yard wetland reflects two analyses: PAH ESBTUs and PCP hazard quotients. Sediment PAH toxicity using the ESBTU approach indicated that two out of three sediment samples have ESBTUs greater than 1 (KCM-PY-DD-1 and KCM-PY-DD-2) with values of 1.9 and 11, respectively. Toxicity testing with the amphipod *Hyalella azteca* supports a threshold for porewater PAHs of approximately 5 to 10 ESBTUs for the effects on 28-day survival (Geiger 2010). *H. azteca* is considered particularly sensitive to sediment contaminants, and a porewater PAH ESBTU of 5 can be considered conservative with respect to protection of the benthic invertebrate community. In addition, the PAH ESBTUs are normalized based on the organic carbon content of the sediment, but sediment total organic carbon (TOC) was not measured in Pine Yard sediment samples, which adds additional uncertainty to the evaluation of PAHs in Pine Yard sediments.

For PCP, only one out of the three sediment samples in the Pine Yard had a hazard quotient greater than 1, location KMC-PY-DD-1 with hazard quotients ranging from 1 to 5. Estimates of PCP porewater concentrations may be uncertain due to the lack of data on sediment pH and TOC and elevated detection limits.

The water chemistry measurement endpoint for benthic invertebrates in the Pine Yard wetland is based on comparison of concentrations of PAHs in surface water to final chronic values (FCVs) to yield toxic units. This evaluation is inconclusive as there were a substantial number of non-detect results for PAHs in the Pine Yard surface water. Individual PAH toxic units ranged from 0.06 to 0.79 for the five detected PAH concentrations. In addition, the final chronic values were based on dissolved PAH concentrations, and surface water data were analyzed only for the total fraction.

The BERA concludes that given the data currently available, it is not possible to rule out the potential for adverse effects in benthic invertebrates from PAHs and PCP in sediment in some areas of the Pine Yard. However, the hazard quotients for these constituents are conservative because the site-specific chemistry data (e.g., pH and TOC) are not available to support consideration of factors that are likely to limit the bioavailability of these COPECs.

**Wildlife**

Current conditions onsite in the northern terrestrial and wetland portion of the Pine Yard are not predicted to pose significant adverse effects to omnivorous birds and mammals (i.e., mallard and raccoon). EPA's review comments on the BERA requested changes to TRVs and exposure assumptions; the effects of those revisions on the overall risk conclusions are not known at this time.

Modeled dietary intake of PAHs and PCP for invertivorous mammals (i.e., short-tailed shrew) in the terrestrial Pine Yard yielded hazard quotients greater than 1. Modeled dietary intakes of copper, mercury, low molecular weight PAHs, and PCP for invertivorous birds (i.e., American robin) in the terrestrial Pine Yard yielded hazard quotients greater than 1. Consequently, the BERA could not rule out the potential for adverse effects in invertivorous mammals and birds foraging in the northern portion of the Pine yard prior to remediation.

In summary, the BERA found ecological risks to receptors due to dietary exposure to surface soils and biotic media[7] in the terrestrial portion of the Pine Yard. Most of these risks are associated with OU-1 surface soils in the northern Pine Yard, where concentrations of COPECs are elevated. Chemical concentrations in these surface soils also were predicted to pose a potential risk to human receptors. It is expected that remediation of OU-1 soils to address human health risks will result in a post-remedy condition under which residual ecological risks are acceptable for terrestrial ROIs following site development. Potential risks to receptors in the wetlands portion of the Pine Yard are uncertain pending final resolution of EPA comments to the draft BERA (Ramboll Environ 2017).

[7] Chemical concentrations in biotic media were calculated from soil concentrations using bioaccumulation factors.

# 2 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section presents the basis for identification, evaluation, and selection of remedial technologies and process options that were considered in the development of the remediation alternatives presented in Section 4.

## 2.1 REMEDIAL ACTION OBJECTIVES

RAOs are medium- or operable unit-specific goals for protecting human health and the environment. OU-1 soils contain COCs that exceed conservative, health-based screening criteria.

### 2.1.1 Chemicals of Concern

The majority of COPCs and COPECs in the Pine Yard is associated with wood treating-related chemicals (primarily PAHs and PCP), although arsenic, copper, chromium[8], carbazole, dioxins (TEQdf), and mercury have also been detected at levels that pose a potential human health and/or ecological risk in several soil samples from the Pine Yard.

### 2.1.2 Applicable or Relevant and Appropriate Requirements

As required under Section 121 of CERCLA, remedial actions carried out under Section 104 or secured under Section 106 must be protective of human health and the environment and attain the levels or standards of control for hazardous substances, pollutants, or contaminants specified by the applicable or relevant and appropriate requirements (ARARs) of federal environmental laws and state (if more stringent) environmental and facility siting laws, unless waivers are obtained. In addition to ARARs, other potentially applicable advisories, criteria, or guidance may be identified by EPA and its supporting agencies. The "to be considered" (TBC) category consists of advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be applicable and useful for CERCLA remedy development.

The requirement that ARARs be identified and complied with, and the development and implementation of remedial actions, is found in Section 121(d)(2) of CERCLA (United States Code [USC] Section 9621(d)(2)). Section 121(d)(2) requires that, for any hazardous substance remaining onsite, all federal and state environmental and facility siting standards,

[8] As detailed in the HHRA, chromium in surface soil at the Pine Yard contributed $1\times10^{-4}$, or 4.6 percent, of the residential excess lifetime cancer risk. Chromium was not retained as a COC for Pine Yard given the isolated exceedances of chromium compared to regional background and the conservative treatment of total chromium as chromium(VI).

requirements, criteria, or limitations, shall be met at the completion of the remedial or removal action, to the degree that those requirements are legally applicable or appropriate and relevant under the circumstances present at the site.

The degree to which these environmental and facility siting requirements must be met, varies, depending on the applicability of the requirements. Applicable requirements must be met to the full extent required by law. CERCLA Section 121(e)(1) provides that permits are not required when a response action is taken "on-site." The NCP defines the term "onsite" as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for the implementation of the response action" (40 CFR 300.5). Although permits are not required, the substance of the applicable permits must be met (USEPA 1988b).

#### 2.1.2.1 Applicable Requirements

Applicable requirements pertain to those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable. Applicable requirements are defined in the NCP, at 40 CFR 300.5-Definitions.

#### 2.1.2.2 Relevant and Appropriate Requirements

Relevant and appropriate requirements pertain to those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site per se, address problems or situations sufficiently similar to those encountered at the CERCLA site, that their use is well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate. Relevant and appropriate requirements are defined in the NCP, at 40 CFR 300.5-Definitions.

#### 2.1.2.3 Other Requirements to Be Considered

In accordance with the NCP [CFR 300.400(g)(3)], other requirements to be considered consist of federal and state criteria, advisories, guidelines, or proposed standards that are not generally enforceable but are advisory and that do not have the status of potential ARARs. Guidance documents or advisories "to be considered" in determining the necessary level of remediation for protection of human health or the environment may be used where no specific ARARs exist for a chemical or situation, or where such ARARs are not sufficient to be protective.

#### 2.1.2.4 Waivers of ARARs

CERCLA Section 121(d)(4) includes situations where compliance with an identified ARAR may be waived when justified [40 CFR 300.430(f)(1)(ii)(C)]. The situations eligible for waivers include:

- The alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant and appropriate federal or state requirement.
- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.
- Compliance with the requirement is technically impracticable from an engineering perspective.
- The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.
- Where remedial actions are selected that do not attain ARARs, the lead agency must publish an explanation in terms of these waivers. The "fund balancing waiver" applies only to Superfund-financed remedial actions. ARARs apply to actions or conditions located onsite. Onsite actions implemented under CERCLA are exempt from administrative requirements of federal and state regulations, such as permits, as long as the substantive requirements of the ARARs are met. Offsite actions are subject to the full requirements of any legally applicable standards or regulations, including all administrative and procedural requirements. Based on the CERCLA statutory requirements, the remedial actions developed in this FFS will be analyzed for compliance with federal and state environmental regulations. This process involves the initial identification of potential requirements, the evaluation of the potential requirements for applicability or relevance and appropriateness, and finally a determination of the ability of the remedial alternatives to achieve the ARARs.

### 2.1.3 Identification of the ARARs

The ARARs for the OU-1 removal action were provided by EPA, which evaluated the following three classifications of requirements in its ARAR determination process:

- Chemical-specific—Laws and requirements that establish health- or risk-based numerical concentration limits or assessment methodologies for chemical contaminants in environmental media. No chemical-specific ARARs were identified for this removal action.
- Location-specific—Requirements that can restrict or limit response action based upon specific locations (e.g., wetlands, floodplains, historic places, or sensitive habitats). Table 2-1 lists potential sources of location-specific ARARs for OU-1. Key considerations

in the ARAR determination process include 1) a portion of the Pine Yard falls within the 100-year floodplain and 2) a separate area of the Pine Yard consists of a forested wetland (Section 1.2.1).

- Action-specific—Requirements that set controls or restrictions on the design, implementation, and performance levels of activities related to the management of hazardous substances, pollutants, or contaminants. Table 2-2 lists potential sources of action-specific ARARs for OU-1.

### 2.1.4 Remedial Action Objectives

The following RAOs have been identified for OU-1:

- Prevent unacceptable risk to humans from exposure to soil with concentrations of COCs above health-based criteria
- Prevent offsite migration of soil COCs from stormwater runoff or wind dispersion of fugitive dust.

As outlined in the approved OU-1 Removal Action Work Plan (Integral 2018b), OU-1 removal action levels (RALs) were developed in collaboration with EPA and MDEQ for surface soils (0–2 ft bgs) based on residential and commercial/industrial land use, as well as for protection of future construction workers due to potential exposure to surface soils during excavation (Table 2-3). RALs are provided for all of the COCs identified in the draft HHRA (Integral 2018a). Key considerations in developing the RALs are summarized below:

- The TEQdf RALs correspond to a noncancer target hazard index of 1, which is consistent with EPA's policy for dioxins that specifies that noncancer toxicity criteria for tetrachlorodibenzo-*p*-dioxin will be used to develop site-specific risk-based cleanup levels at Superfund sites.[9]
- Soil RALs for PAHs, PCP, and carbazole correspond with the lower (i.e., more conservative) of an excess lifetime cancer risk of $1\times10^{-6}$ or a noncancer hazard index of 1 for residential soils, and the lower of an excess lifetime cancer risk of $1\times10^{-5}$ or a noncancer hazard index of 1 for industrial/commercial or construction worker scenarios.
- RALs for residential and industrial/commercial surface soil are equivalent to EPA's RSLs, or a scaled factor of those RSLs, whereas RALs for subsurface soils (i.e., to be protective of a construction worker scenario) are calculated based on conservative exposure parameters for a construction worker (see draft HHRA, Appendix G for derivation).

[9] https://www.epa.gov/superfund/risk-assessment-dioxin-superfund-sites

- For nonresidential surface soil, the lower of the industrial/commercial and construction worker RALs will be applied.
- The RAL for arsenic is based on natural background for the region (Integral 2018a).
- Cleanup to the RALs described above and summarized in Table 2-3 is anticipated to result in a post-remedy site condition that is protective of ecological ROIs.

The draft HHRA found no unacceptable risk to construction workers exposed to Zone 3 soil in the Pine Yard (Section 1.2.6.1); therefore, there are no human health-based RALs for subsurface soils (>2 ft bgs).

## 2.2 GENERAL RESPONSE ACTIONS

A general response action (GRA) is a media-specific generic technology or administrative method for addressing contamination and achieving RAOs at CERCLA sites. GRAs applicable to contaminated OU-1 surface soil were taken from remediation guidance documents (USEPA 1988a) and are summarized below.

| General Response Action | Description |
|---|---|
| No Action | No remedial action is taken and all contamination is left in place. |
| Institutional Controls | Administrative and/or legal methods that limit exposure of potential receptors to contaminated media. |
| Monitoring | Measurement of contaminant concentrations over time to determine changes and trends in contaminant nature and extent. |
| Containment/Isolation | Engineered barriers that prevent/limit contaminant migration, receptor from contacting contamination, and/or prevent clean media from becoming contaminated. |
| Removal | Removal of contaminated media from its original location. |
| Treatment | Use of *in situ* or *ex situ* technologies to chemically degrade and/or physically stabilize contaminants. |
| Disposal | Placement of contaminated media in a new, controlled location that eliminates potential exposure pathways between receptors and contaminated media. |

### 2.2.1 No Action

No action is a baseline GRA scenario for the evaluation of alternative GRAs. No remedial action or monitoring would be performed under the no action GRA—providing a baseline assessment of the impact of the "as is" condition on potential receptors.

### 2.2.2 Institutional Controls

Institutional controls include administrative tools (e.g., informational signage) and legal instruments (e.g., restrictive covenants or negative easements) designed to limit exposure to contaminated media to protect human health by limiting potential exposure to contaminated media left in place at a site. Institutional controls can be used as the primary component of a remedial alternative or in combination with other remediation technologies and process options (RTPOs) to minimize or prevent exposure to contaminated media left in place at a given site (USACE and USEPA 2000). The NCP emphasizes that institutional controls, such as land-use restrictions, are meant to supplement RTPOs during all phases of cleanup and may be a necessary component of the final remedy.

### 2.2.3 Monitoring

Monitoring is a common GRA to all active remediation alternatives to provide the data necessary to determine if the remedial action has successfully achieved RAOs and cleanup standards. Monitoring involves media sampling and analysis of contaminant concentrations and other ancillary variables to track the progress and overall effect of a remedial action.

### 2.2.4 Containment/Isolation

The containment/isolation GRA is intended to isolate COCs in soils from potential receptors and/or environmental media though the use of a physical barrier, thereby breaking a potential exposure pathway. Contaminated soils are left in place with this GRA and thus containment/isolation is frequently used in combination with institutional controls to provide for long-term protection of human health and the environment.

### 2.2.5 Removal

Removal of soil contamination is typically accomplished through excavation. Complete removal of contamination from a site immediately achieves RAOs and cleanup goals; however, full removal is not always achievable due to site-specific limitations (e.g., depth and/or extent of contamination, presence of adjacent structures, presence of groundwater).

### 2.2.6 Treatment

Treatment involves the use of chemical, biological, and/or physical processes to cause the destruction or alteration of the contamination to a form that is less toxic and/or less mobile. Treatment can be achieved *in situ* (i.e., in place) or *ex situ* (i.e., aboveground following excavation). *Ex situ* treatment can be applied to excavated soils to support disposal of soils (e.g., addition of solidifying agents to pass paint filter and/or toxicity characteristic leaching procedure [TCLP] testing to allow for disposal as a nonhazardous waste).

### 2.2.7 Onsite Consolidation and Offsite Disposal

Onsite consolidation refers to the placement of excavated soils in an onsite location with an appropriately designed low-permeability cap.

Offsite disposal involves the disposal of excavated soils in an appropriately permitted offsite facility (e.g., a landfill) for protective management that precludes exposure pathways.

## 2.3 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Each GRA described above (except no action) can involve one or more technology type. Remediation technologies refer to general categories of technology types. Process options refer to specific methods or types of equipment within each technology type. Specific RTPOs for the GRAs identified for the OU-1 soils are summarized below.

| General Response Action | Specific Remedial Technology and Process Options |
|---|---|
| Institutional Controls | Restrictive Covenants<br>Easements<br>Informational Devices |
| Monitoring | Construction Monitoring<br>Long-Term Monitoring |
| Containment/Isolation | Cap/Cover |
| Removal | Excavation |
| Treatment | *In Situ* Stabilization<br>*Ex Situ* Stabilization<br>*In Situ* Chemical Amendment<br>Land Farming<br>Soil Washing |
| Consolidation and Disposal | Landfill Disposal<br>Onsite Consolidation |

### 2.3.1 Criteria for Screening of Remedial Technologies and Process Options

The RTPOs identified for OU-1 soils were evaluated to identify those that are most viable to the site-specific conditions. Each RTPO was screened against the criteria described below:

- Effectiveness—The effectiveness of a given RTPO refers to the likelihood that it will be effective at reducing the toxicity, mobility, and/or volume of the COCs in OU-1 soils given the specific conditions at the Site. Each RTPO was evaluated for effectiveness based on demonstrated success at similar sites/conditions.
- Implementability—This criterion considers the relative ease of implementing the RTPO and considers factors such as availability of the materials and services to implement the RTPO and the depth of contamination.
- Relative Cost—This criterion considers the capital and O&M costs to implement the RTPO.

### 2.3.2 Identification, Screening, and Evaluation of Technologies

Figure 2-1 summarizes the results of the RTPO screening process, which is described for each GRA below.

#### 2.3.2.1 Institutional Controls

Although institutional controls alone do not reduce the toxicity, mobility, or volume of contamination at a site, they can be conditionally effective at preventing exposure of human receptors to contaminated soils. Institutional controls retained as options for OU-1 are as follows:

- Government Controls—Zoning restrictions or local ordinances
- Property Controls—Deed restrictions, easements, covenants
- Information Tools—Public notices, signage.

These institutional controls would most likely be used in combination with other RTPOs to achieve a remedy that is protective of human health and the environment. A common institutional control is a land use or deed restriction that specifies soil handling and management procedures following completion of the remedial action. Institutional controls are implementable and are low cost relative to other RTPOs. Institutional controls are retained as an RTPO to be included as a component of all of the active remedial alternatives.

#### 2.3.2.2 Monitoring

Monitoring involves collection of soil samples to evaluate the extent of contamination and the progress of remedial actions, and to demonstrate that the remedial action has achieved the RAOs and cleanup goals. Monitoring is retained as an RTPO to be included as a component of all of the active remedial alternatives.

#### 2.3.2.3 Containment/Isolation

Containment/isolation technologies isolate contaminants to prevent their migration and/or eliminate potential exposure pathways. Cap/covers were identified and retained as a containment/isolation technology for OU-1 soils. Cap/covers involve the placement of a soil cover and/or multimedia cap to isolate potential human receptors from contamination in soils. Cap/covers leave contamination in place and are not effective at reducing contaminant toxicity or volume. A cap or cover reduces potential contaminant mobility through stormwater or wind erosion and a low permeability cap can reduce the potential mobility of soil contaminants by limiting infiltration.

A cap/cover would be employed in conjunction with institutional controls to ensure integrity of the cap/cover and to ensure that proper precautions and practices are implemented during activities (e.g., excavation of utility corridors) that could disturb the cap/cover and lead to potential exposure to contaminated soils beneath the cap/cover. Cap/covers are implementable at the Site and have low costs relative to other RTPOs. Cap/covers are retained as an RTPO for consideration in the development of remedial alternatives.

#### 2.3.2.4 Removal

Removal is accomplished via excavation using conventional construction techniques. Removal is highly effective at reducing/eliminating the toxicity, mobility, and volume of soil contamination. Because the depth of contamination of OU-1 soils is relatively shallow (< 8 ft) and does not require excavation below the water table, conventional construction techniques and equipment can be employed and are readily implementable. Removal generally has a high cost relative to other RTPOs.

#### 2.3.2.5 Treatment

Two *in situ* and three *ex situ* treatment RTPOs were identified as potentially viable for OU-1 soils. The screening of these RTPOs is discussed below:

- *In Situ* Stabilization—*In situ* stabilization involves the mixing of chemical reagents, such as cement, to create a solid "monolith" matrix that isolates contaminated soils from potential exposure or migration. Although stabilization has been shown to be highly effective at other wood treatment sites, it is not because of the inconsistency of the posttreatment site conditions with the desired future redevelopment of the Pine Yard. Stabilization results in a solid matrix that is greater in volume than the original soils, which would place limits on future construction options. These conditions and the fact that the contamination would remain in place at the Site would limit the desirability of the Pine Yard for future redevelopment. As a result, *in situ* stabilization is not retained for further consideration.

- *In Situ* Chemical Amendments—*In situ* chemical amendments involve the addition of specific chemical reagents to either degrade/destroy COCs or bind the COCs in soils and thereby reduce the toxicity, mobility, and volume of the contaminants. Chemical oxidants can be effective for treatment of organic contaminants, such as PAHs, and sorbents, such as iron oxides, can be effective for some inorganic contaminants, such as arsenic. However, chemical amendments have not been shown to be reliably effective for TEQdf. As a result, *in situ* chemical amendments are not retained for further consideration.
- *Ex Situ* Stabilization—*Ex situ* stabilization involves the mixing of chemical reagents, such as cement, with excavated soils to reduce COC mobility. Commonly, *ex situ* stabilization is used to reduce contaminant mobility in characteristically hazardous wastes (i.e., soils that fail TCLP testing) to allow for disposal in a Subtitle D landfill. The OU-1 soils have been shown to be non-hazardous; thus, *ex situ* stabilization is considered unnecessary and is not retained for further consideration.
- Land Farming—Land farming involves the placement of excavated soils in treatment cells to facilitate the physical (e.g., volatilization, photodegradation) and biological degradation of contaminants. Historically, land farming was commonly applied to treat soils at wood treatment sites. However, the technology has had mixed success in the treatment of creosote-impacted soils and would not be effective for TEQdf. As a result, land farming is not retained for further consideration.
- Soil Washing—Soil washing involves contacting excavated contaminated soils with water to remove contaminants by dissolving or suspending them in the wash solution (often augmented with a surfactant or chelating agent to improve contaminant removal efficiency) or by concentrating them into a smaller volume of soil through separation. Soil washing is unlikely to be effective for the asphalt-like creosote, which is present as large cobbles or layers and has limited permeability to facilitate contact with wash solutions. Because these asphalt like layers make up a large portion of the OU-1 soil contamination, soil washing is not retained for further consideration.

#### 2.3.2.6 Onsite Consolidation and Offsite Disposal

Following removal, excavated soils would require placement in an onsite consolidation facility or disposal at an appropriately permitted offsite landfill.

Site-specific testing has shown that soils in OU-1 are non-hazardous and have been approved for disposal at the nearby Golden Triangle, Subtitle D landfill. Further, the Multistate Trust has made good faith efforts to determine whether remediation waste generated during a removal action would be considered a listed waste, as documented in Appendix D. The Multistate Trust has been unable to make such a determination because documentation regarding the source of contamination, contaminant, or waste is unavailable or inconclusive. EPA guidance (Management of Remediation Waste Under RCRA; USEPA, October 1998) states the Multistate Trust may assume the source contaminant or waste is not a listed hazardous waste. Therefore, for the purposes of this FFS, both onsite consolidation and offsite disposal at a permitted RCRA Subtitle D facility have been retained as RTPOs for consideration in the development of remedial alternatives.

Offsite disposal in a Subtitle C landfill is also retained for future consideration, in the event that materials meeting the definition of a RCRA hazardous waste are encountered during the OU-1 removal.

# 3 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

This section describes the remedial alternatives that were developed from the RTPOs that were retained during the screening process described in Section 2. Each remedial alternative includes a combination of RTPOs and was developed to provide a range of options for achieving the RAOs and ARARs. An analysis of each alternative is presented based on the nine criteria defined under CERCLA.

## 3.1 EVALUATION CRITERIA

The nine criteria defined under CERCLA for evaluation of remedial action alternatives fall into three categories—threshold criteria, primary balancing criteria, and modifying criteria.

- Each alternative must be capable of meeting the following two **threshold criteria**:
  - *Overall Protection of Human Health and the Environment*—Protectiveness of human health and the environment is based on an evaluation of each alternative's ability to meet the RAOs.
  - *Compliance with ARARs*—Each alternative is evaluated to determine how it complies with or can be modified to comply with federal and state ARARs.
- The comparative analysis of alternatives is then based on the following five **primary balancing criteria**:
  - *Long-Term Effectiveness and Permanence*—This criterion requires an evaluation of the potential long-term risks remaining after implementation of the remedy. Issues addressed for each alternative include the magnitude of long-term risks, and the long-term reliability of the management controls.
  - *Short-Term Effectiveness*—The evaluation of short-term effectiveness is based on the protectiveness of human health achieved during the construction and implementation phase of the remedial action. Key factors to be considered by this evaluation include time required for remedy implementation (construction duration) and associated risks to local residents, site workers, and the community. Such issues include the duration and frequency of truck traffic through the community and associated risks (e.g., accidents) and nuisances (e.g., noise, emissions).
  - *Reduction of Toxicity, Mobility, or Volume through Treatment*—This criterion addresses the preference under CERCLA for remedial alternatives that permanently and significantly reduce the mobility, toxicity, or volume of hazardous substances through treatment.

- *Implementability*—The implementability of each alternative is evaluated based on its technical and administrative feasibility, and the availability of services and materials. Technical feasibility takes into consideration difficulties that may be encountered during construction and operation. Administrative feasibility factors include coordination with other offices and agencies, such as obtaining permits or approvals for various onsite and offsite activities.
- *Cost*—Evaluation of the cost of each alternative includes estimation of capital costs, O&M costs, and the net present worth (NPW) based on a 30-year O&M period.[10] The NPW cost provides a means of comparing the total costs of different alternatives with different O&M requirements and duration. All of the costs are presented in a format consistent with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (USACE and USEPA 2000).

- After EPA issues its Proposed Plan for OU-1, the following two **modifying criteria** will be considered in the Record of Decision:
  - *Regulatory Acceptance*—City and state acceptance will be determined based on comments and input received during the FFS review and approval process.
  - *Community Acceptance*—Formal evaluation of the community responses and/or concerns regarding the alternatives will consider input from the public during public meetings, and written comments on EPA's proposed plan. However, the FFS informally addresses community acceptance of each alternative based on anticipated feedback and concerns from the community.

## 3.2 ALTERNATIVE 1—NO ACTION

### 3.2.1 Description

The no action alternative is required under the NCP to provide a baseline scenario against which all other alternatives are compared. Under the no action alternative, no funds are expended for remediation of OU-1 soils. The minimum activities for the no action alternative include the mandatory five-year reviews over the course of a 30-year period, resulting in a total of six five-year reviews.

[10] A 0.0% discount rate was used for a realistic estimation of potential future costs because the current interest rate is 0.7%.

### 3.2.2 Evaluation

The following table presents an evaluation of the no action alternative relative to the CERCLA criteria.

| Criteria | Analysis |
|---|---|
| Overall Protection of Human Health and the Environment | The no action alternative is not protective of human health or the environment. This alternative does not eliminate any exposure pathways or reduce the level of risk of the existing media contamination. |
| Compliance with ARARs | This alternative does not achieve the RAOs established for the Site. Location- and action-specific ARARs do not apply to this alternative since remedial actions will not be conducted. |
| Long-Term Effectiveness and Permanence | Long-term effectiveness is poor as the current level of contamination and associated risk is not projected to change substantially with time. Because contaminants remain under this scenario, a review/reassessment of the conditions at the Site would be performed at 5-year intervals. |
| Reduction of Toxicity, Mobility, or Volume through Treatment | This alternative will minimally reduce the toxicity, mobility, or volume of COCs. Some of the COPCs (e.g., naphthalene) can be expected to degrade naturally over time; however, an extended time frame (decades) may be required before notable changes in concentrations occurs. |
| Short-Term Effectiveness | This remedy is not expected to have any significant short-term effectiveness. |
| Implementability | The no action alternative is easily implemented. |
| Cost | $180,000 (expected accuracy of +50 to −30 percent) |

## 3.3 ACTIVE REMEDIAL ALTERNATIVES

The following section describes three active remediation alternatives developed to address Zone 2 soils that contain COC concentrations that exceed health-based cleanup goals and Zone 3 soils with visible impacts. The areal and vertical extents of these soils are described in Section 1.2.4.

Each of the active remedial alternatives includes institutional controls as a common element to increase awareness and to minimize the potential for exposure to any contamination left in place. The specific nature of the institutional controls may vary between alternatives. For example, Alternative 4, which involves the placement of a cover to isolate contamination left in place, will require stricter land use restrictions than the other two alternatives, which involve full removal of OU-1 contaminated soils from the Pine Yard. It is anticipated that institutional controls will be required for all alternatives to 1) specify soil management protocols to protect against potential exposure to contamination either purposely or inadvertently left in place following remedial action, and 2) specify conservation of the wetlands area.

Also as a common element, each remedial alternative includes mandatory five-year reviews over the course of a 30-year period, resulting in a total of six five-year reviews.

## 3.3.1 Alternative 2—Removal and Offsite Disposal

### 3.3.1.1 Description

Alternative 2 includes the following elements:

- Excavation of Zone 2 soils with COC concentrations that exceed health-based cleanup goals and where visible contamination is present and excavation of Zone 3 soils where visible contamination is present. Figure 1-4 presents the estimated extent of Zone 2 impacted soils and the estimated extent of known Zone 3 impacted soils.
- To the extent practicable, excavated soils with no visible evidence of contamination will be segregated from visibly-contaminated soils and analyzed to determine if the soils are suitable for use as Beneficial Reuse Material as specified in Section 4.1.1 of the approved OU-1 Removal Action Work Plan (Integral 2018b) within the areas of the Pine Yard identified for potential future industrial/commercial use. Excavation areas within OU-1 that have been identified for potential future residential use will be backfilled only with soils that meet the criteria for Imported Backfill Material as specified in Section 4.1.1 of the approved OU-1 Removal Action Work Plan.
- Offsite disposal of excavated contaminated soils as RCRA non-hazardous waste at a Subtitle D landfill, such as the Golden Triangle Regional Landfill in Starkville, Mississippi.
- Offsite disposal, including any required pre-treatment, of unanticipated materials that may be encountered during construction and subsequently determined to contain RCRA hazardous wastes, in a permitted RCRA Subtitle C landfill approved by EPA in accordance with the Off-site Rule in the NCP at 40 CFR 300.440.
- Confirmation sampling and analyses to demonstrate that cleanup goals have been achieved.
- Placement of Imported Backfill Material in areas identified for potential future residential use. Beneficial Reuse Material will be placed in areas identified for potential future industrial/commercial use, and Imported Backfill Material will be placed if needed to achieve final grades.

- Implementation of institutional controls maintained by property owner.
- No O&M required.
- Six- to 9-month implementation time frame.
- Mandatory five-year review.
- Portions of the Pine Yard will be available for an unrestricted surface land use upon achieving performance standards at the completion of construction.

#### 3.3.1.2 Evaluation

Removal of soils with concentrations exceeding conservative health-based cleanup goals would be a highly-effective and permanent remedy for OU-1 soils, and would meet all of the CERCLA criteria, as is summarized below.

| Criteria | Analysis |
|---|---|
| Overall Protection of Human Health and the Environment | This alternative would be protective of human health and environment by removing soils that contain COCs at concentrations that exceed conservative health-based levels. |
| Compliance with ARARs | This alternative would achieve the RAOs and the location- and action-specific ARARs. |
| Long-Term Effectiveness and Permanence | This alternative would have a high degree of long-term effectiveness as the soils that contain COCs at concentrations that exceed conservative health-based cleanup goals would be permanently removed from the Site and disposed of in a landfill. |
| Reduction of Toxicity, Mobility, or Volume through Treatment | Removal under this alternative would substantially reduce/eliminate the volume of contamination in Pine Yard OU-1 soils and thereby substantially reduce/eliminate the COC toxicity and mobility associated with OU-1 soils. |
| Short-Term Effectiveness | This alternative would be effective immediately upon completion of the removal action; however, there is the potential for short-term impacts to workers and the community (e.g., due to dust, truck traffic) and for nuisance issues (e.g., odors) during the active remediation construction period. Potential short-term impacts can be readily and effectively managed through well-established engineering controls. |
| Implementability | This alternative utilizes well-established techniques and technologies, and does not require specialized services or equipment. There are no known challenges to completing this alternative that cannot be addressed through proper engineering design and construction. |
| Cost | $9,892,000 (expected accuracy of +50 to –30 percent) |

### 3.3.2 Alternative 3—Removal and Onsite Consolidation

#### 3.3.2.1 Description

Alternative 3 includes the following elements:

- Excavation of Zone 2 soils with COC concentrations that exceed health-based cleanup goals and where visible contamination is present, and excavation of Zone 3 soils where significant visible contamination is present. Figure 1-4 presents the estimated extent of Zone 2 impacted soils and the estimated extent of known Zone 3 impacted soils.
- Consolidation of excavated contaminated soils beneath a low permeability cap. Consolidation under this alternative would be integrated in with the future remedial action for the Former Plant Area. The draft feasibility study for the Former Plant Area is in progress and identifies onsite consolidation as an RTPO. Under OU-1 Alternative 3, soils excavated from Zones 2 and 3 would be consolidated in an area within the Former Plant Area and potentially may be used as backfill in areas where heavily-impacted source materials (e.g., soils containing creosote free product) are removed from the Former Plant Area. If this alternative is selected, an interim staging pile would be used to manage excavated OU-1 soils until the remedy for the Former Plant Area is selected, designed, and implemented.
- Confirmation sampling and analyses to demonstrate that cleanup goals have been achieved.
- Placement of clean backfill.
- Implementation of institutional controls maintained by property owner.
- Six- to 9-month implementation time frame for construction. However, implementation of this alternative would likely be delayed relative to other alternatives as this alternative requires integration with the remedial alternative selection and implementation for the Former Plant Area. Further, establishing institutional controls could be longer.
- O&M of onsite consolidation area.
- Mandatory 5-year review.
- Portions of the Pine Yard will be available for an unrestricted surface land use upon achieving performance standards at the completion of construction.

#### 3.3.2.2 Evaluation

Removal of soils with concentrations exceeding conservative health-based levels would be a highly-effective remedy for OU-1 soils, and would meet all of the CERCLA criteria, as is summarized below. However, the contaminated soils would remain in place as an encumbrance to the future use of the Former Plant Area.

| Criteria | Analysis |
|---|---|
| Overall Protection of Human Health and the Environment | This alternative would be protective of human health and environment by removing soils that contain COCs at concentrations that exceed conservative health-based levels. |
| Compliance with ARARs | This alternative would achieve the RAOs and location- and action-specific ARARs. |
| Long-Term Effectiveness and Permanence | This alternative would have a high degree of long-term effectiveness as the soils that contain COCs at concentrations that exceed conservative health-based cleanup goals would be permanently removed from the Pine Yard; however, the contaminated soils would be contained beneath a low-permeability cap in the Former Plant Area. Thus, institutional controls and cap monitoring and maintenance would be required into the foreseeable future to ensure the integrity of the cap. |
| Reduction of Toxicity, Mobility, or Volume through Treatment | Removal under this alternative would substantially reduce/eliminate the volume of contamination in contaminated soils in the Pine Yard and thereby substantially reduce/eliminate the COC toxicity and mobility associated with OU-1 soils. However, the alternative would result in an increase in the volume of contaminated soils in the Former Plant Area. |
| Short-Term Effectiveness | This alternative would be effective immediately upon completion of the removal action; however, there is the potential for short-term impacts to workers and the community (e.g., due to dust, truck traffic) and for nuisance issues (e.g., odors) during the active remediation construction period. Further, depending on the staging of the OU-1 and Former Plant Area remedial actions, there is a potential that the excavated soils would require stockpiling for a period of time—presenting a potential risk for contaminant transport during that period. These potential issues can be readily and effectively managed through well-established engineering controls. |
| Implementability | This alternative utilizes well-established techniques and technologies, and does not require specialized services or equipment. There are no known challenges to completing this alternative that cannot be addressed through proper engineering design and construction. Because the alternative relies on integration with the Former Plant Area remedial action, which has not yet been selected, there are potential administrative and schedule/logistical challenges to implementation of this alternative. |
| Cost | $6,465,000 (expected accuracy of +50 to –30 percent) |

### 3.3.3 Alternative 4—Cover

#### 3.3.3.1 Description

Alternative 4 includes the following elements:

- Placement of a 2-ft thick semipermeable soil cover, meeting applicable solid waste landfill requirements, over soils that contain COC concentrations exceeding health-based cleanup goals and where visible contamination is present (Figure 1-4).
- Implementation of institutional controls maintained by property owner.
- Three- to 6-month implementation time frame for construction. Establishing institutional controls could be longer.
- O&M of cover.
- Mandatory 5-year review.
- Portions of the Pine Yard will be available for an unrestricted surface land use upon achieving performance standards at the completion of construction.

#### 3.3.3.2 Evaluation

Alternative 4 uses containment/isolation to achieve a remedy that is protective of human health and the environment. A soil cover applied in conjunction with institutional controls would prevent exposure to contaminated soils. Alternative 4 would meet all of the CERCLA criteria, as is summarized below. However, the contaminated soils and areas of residual creosote would remain in place beneath the soil cover.

| Criteria | Analysis |
|---|---|
| Overall Protection of Human Health and the Environment | This alternative would be protective of human health and environment by removing or isolating soils that contain COCs at concentrations that exceed conservative health-based levels. |
| Compliance with ARARs | This alternative would achieve the RAOs and the location- and action-specific ARARs. |
| Long-Term Effectiveness and Permanence | This alternative would have a moderate degree of long-term effectiveness as the soils that contain COCs at concentrations that exceed conservative health-based cleanup goals would be isolated beneath a soil cover. Institutional controls and cover monitoring and maintenance would be required into the foreseeable future to ensure the integrity of the soil cover. |
| Reduction of Toxicity, Mobility, or Volume through Treatment | This alternative would reduce the potential mobility of soils beneath the soil cover, primarily by limiting contact with and potential erosion by stormwater; and although the toxicity of these soils would not be reduced, the pathways for exposure would be eliminated. The volume of contaminated soil would not be reduced. |
| Short-Term Effectiveness | This alternative would be effective immediately upon completion of the remedial action; however, there is the potential for short-term impacts to workers and the community (e.g., due to dust, truck traffic) and for nuisance issues (e.g., odors) during the active remediation construction period. These issues can be readily and effectively managed through well-established engineering controls. |
| Implementability | This alternative utilizes well-established techniques and technologies, and does not require specialized services or equipment. There are no known challenges to completing this alternative that cannot be addressed through proper engineering design and construction. |
| Cost | $3,141,000 (expected accuracy of +50 to –30 percent) |

# 4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, the four remedial alternatives identified for OU-1 are comparatively analyzed against the nine CERCLA evaluation criteria. Figure 4-1 summarizes the results of the comparative evaluation.

## 4.1 THRESHOLD CRITERIA

Alternative 1 (no action) does not meet the threshold criteria (Table 4-1). The current conditions of the OU-1 represent an unacceptable, potential hazard, and would not meet the OU-1 RAOs. Without engineering and/or institutional controls there is a potential risk of exposure to OU-1 soils for future site users.

All three of the active remedial alternatives (Alternatives 2, 3, and 4) would meet the threshold criteria. Alternatives 2 and 3 would meet the RAOs by removing OU-1 soils with concentrations of COCs above health-based cleanup goals and replacing those soils with clean backfill. Alternative 4 would employ a soil cover to eliminate risks associated with exposure to OU-1 soils with concentrations of COCs above health-based cleanup goals. With proper design and execution, all three of the active remedies would comply with federal, state, and local ARARs.

## 4.2 BALANCING CRITERIA

Table 4-2 presents a comparative analysis of the four remedial alternatives in terms of the balancing criteria (with the exception of cost). A relative ranking of the alternatives (1 = highest ranked and 4 = lowest ranked) is provided for each balancing criterion, and an overall ranking across all of the balancing criteria is also provided.

Although the no action alternative, by definition, would be inexpensive and readily implementable, it does not attain the objectives of long-term effectiveness and permanence, short-term effectiveness, or reduction of toxicity, mobility, and volume through treatment. The following discusses each of the three active remedial alternatives with respect to the balancing criteria.

### 4.2.1 Long-Term Effectiveness and Permanence

Alternatives 2, 3, and 4 all would substantially attain the criteria of long-term effectiveness and permanence (Table 4-2). Alternatives 2 and 3 would both eliminate OU-1 soils with COC concentrations above health-based cleanup goals from the Pine Yard. Under Alternative 2, excavated soils would be disposed of in an offsite landfill, while under Alternative 3 the soils would be consolidated under a cap within the Former Plant Area of the KMCC site. Thus, although Alternative 3 would eliminate contamination associated with OU-1 soils from the Pine Yard, the contamination would still be present within the boundaries of the Former Main Plant Area—albeit within an engineered containment facility to prevent potential migration or receptor contact. For this reason, Alternative 3 is ranked lower for this criterion than Alternative 2.

Alternative 4 involves isolation of OU-1 soils. Although this alternative has a high degree of certainty with respect to long-term effectiveness and permanence, institutional controls will be required to protect against disturbance of the soil cover and to prevent unacceptable exposure risks associated with potential future excavation work (e.g., to construct building footings or utilities). Therefore, because Alternative 4 leaves impacted soils in place in the Pine Yard, it ranks lower than Alternatives 2 and 3 with respect to long-term effectiveness and permanence.

### 4.2.2 Short-Term Effectiveness

All three of the active remedial alternatives rank similarly high with respect to the short-term effectiveness criterion, and all three alternatives would be immediately effective upon completion of the remedial action.

All three of the alternatives involve the use of conventional construction techniques and potential short-term impacts to workers and the community can be readily addressed though proper design and execution of the remedial action, including use of well-established best management practices. Many of the potential short-term impacts and nuisances associated with the active remedies are related to the excavation, stockpiling, and transport of contaminated soils. Some of the key factors related to these activities include, but are not limited to:

- Inherent hazards associated with the use of heavy machinery
- Potential to generate dusts, chemical vapors, and odors that, without proper controls, can represent a hazard or at least a nuisance to both workers and the adjacent community
- Truck traffic and associated risks (e.g., potential for truck-related accidents) and nuisance (e.g., noise, emissions) posed to the community
- Noise associated with use of heavy machinery and truck traffic
- Potential for release of contaminants to the environment during handling and transport of excavated soils, and due to potential stormwater contact with excavated surfaces and stockpiles.

Alternative 4 does not involve excavation or transport of contaminated soils from the Pine Yard. As a result, Alternative 4 would have the least truck traffic and associated risk/nuisance posed to the community, and thus ranks highest among the alternatives with respect to short-term effectiveness. Conversely, Alternative 2 involves the greatest amount of excavation, and the largest amount and distance of offsite transport of the three alternatives; and therefore ranks the lowest among the alternatives with respect to short-term effectiveness. Alternative 3 involves the same volume of excavation as Alternative 2, but involves the shortest distance for disposal. Therefore, Alternative 3 ranks intermediate between Alternatives 2 and 4.

### 4.2.3 Reduction of Toxicity, Mobility, and Volume

By removing all of the OU-1 soils with COCs above health-based cleanup goals, Alternative 2 would substantially reduce the toxicity, mobility and volume of contamination. Alternative 3 would result in a similar level of reduction in Pine Yard soils; however, the contaminant mass would be transferred to a consolidation area in the Former Plant Area. As a result, there would be no net reduction in contaminant volume or toxicity when the full KMCC Site is considered. The soils would be isolated below a low permeability cap in the Former Plant Area, which would substantially reduce any potential mobility of contaminants associated with the excavated OU-1 soils under Alternative 3. Alternative 4 would not result in a reduction in contaminant toxicity or volume; however, the soil cover would reduce the potential mobility of the contaminants associated with OU-1 soils by isolating the soils from stormwater and wind erosion.

### 4.2.4 Implementability

All three of the active remedial alternatives are relatively easy to construct and involve readily available and highly reliable technologies and equipment, and the effectiveness of all three alternatives can be readily evaluated through monitoring. Alternative 2 does not pose any significant impedances to additional remedial actions in the future, while the cap or cover under Alternatives 3 and 4 may pose some minor impedance to additional remedial action should it be warranted in the future. Alternative 3 also poses a potential logistical challenge in that it relies on consolidation onsite in the Former Plant Area. Because the remedial action for the Former Plant Area has not been selected, it is not clear at this time whether consolidation of Pine Yard OU-1 soils in the Former Plant Area would be compatible or inconsistent with the final remedy selected for the area. Further, the schedule for excavation and consolidation of OU-1 soils in the Former Plant Area would need to be coordinated with implementation of the Former Plant Area remedial action.

### 4.2.5 Costs

At an estimated cost of $3,100,000, Alternative 4 is the lowest-cost alternative. Alternative 3 is estimated to cost $6,500,000, and Alternative 2 is estimated to cost $9,800,000.

## 4.3 MODIFYING CRITERIA

Alternative 1, no action, would not be accepted by the regulatory agencies or the community, nor would it be consistent with future redevelopment of the Pine Yard. Of the three active alternatives, it is anticipated that Alternative 2 would be favored by the regulatory agencies and by the community, as it is the most effective and permanent remedy. Although both Alternatives 3 and 4 could be acceptable to the agencies and the community, Alternative 4 would leave contamination onsite and would encumber the Pine Yard with land-use restrictions. Such restrictions could reduce the desirability of the property for redevelopment, and thus Alternative 4 is viewed less favorably than the full removal option (Alternative 2). Alternative 3 would achieve the same conditions in the Pine Yard as Alternative 2; however, the fact that the contaminated soils would be consolidated at the Former Plant Area is considered unfavorable to the regulatory agencies and the community.

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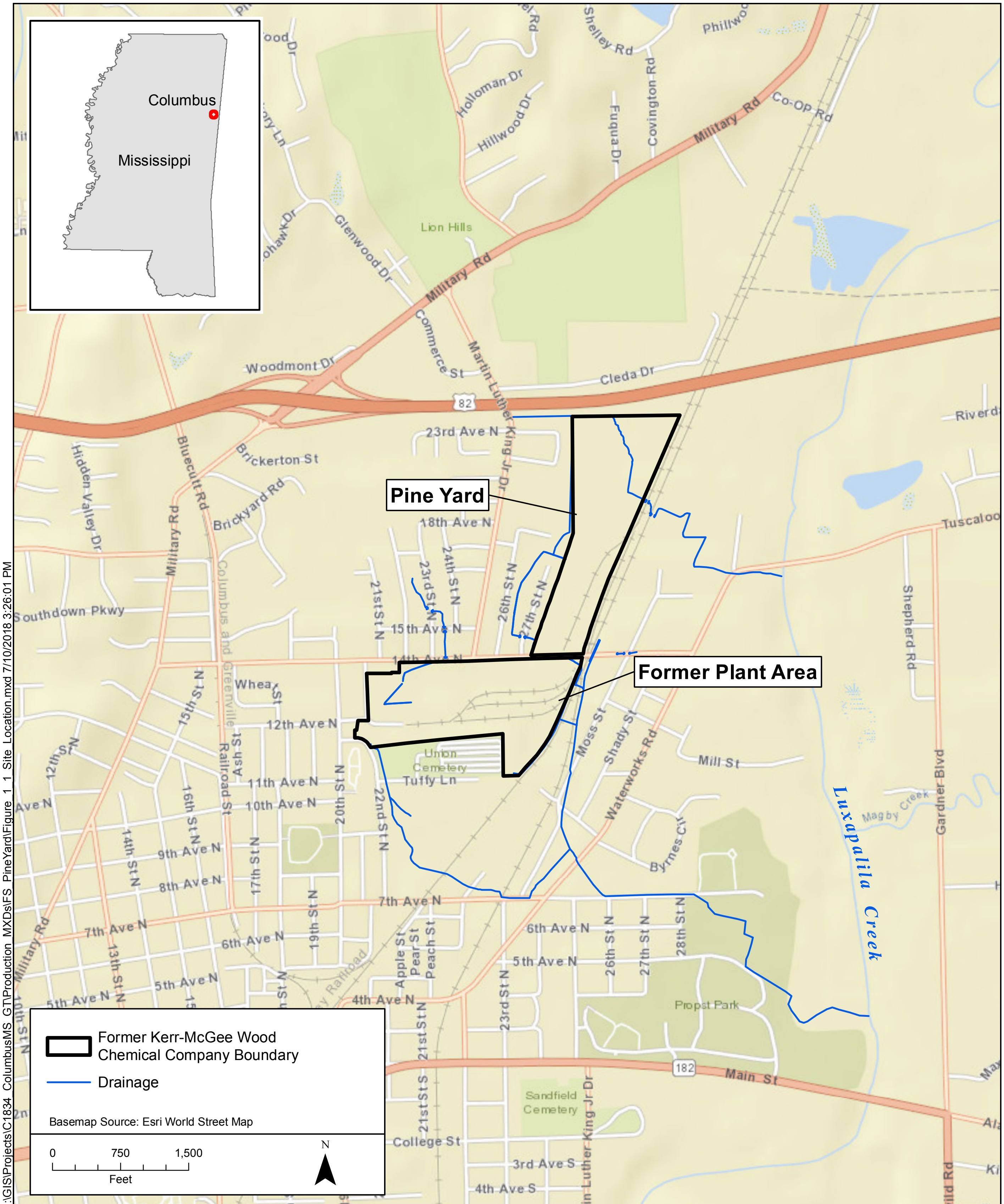
# FIGURES

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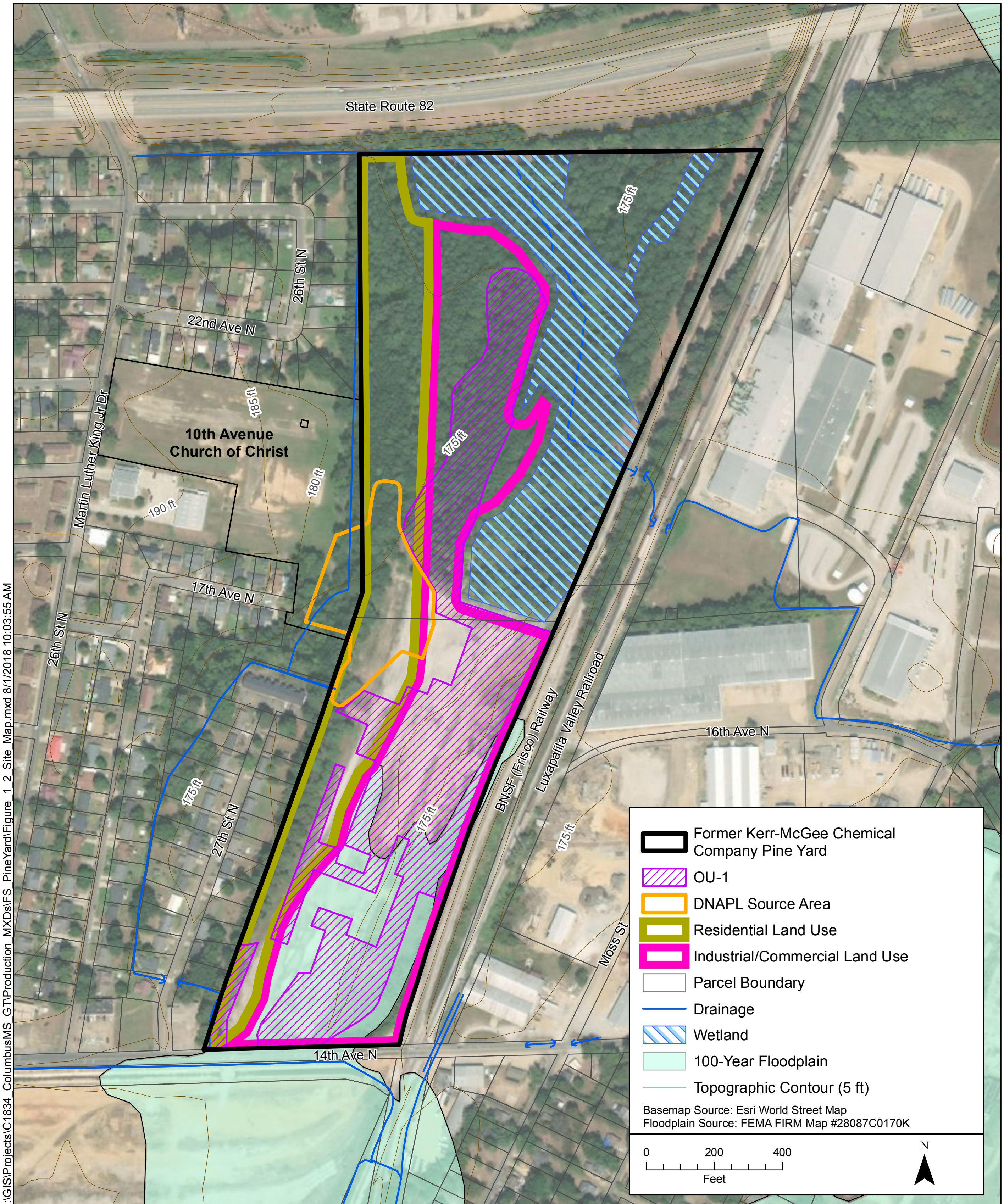
Prepared for: Greenfield Environmental Multistate Trust, LLC
Trustee of the Multistate Environmental Response Trust

Prepared by: integral consulting inc.

**Figure 1-1.**
Vicinity Site Map
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018

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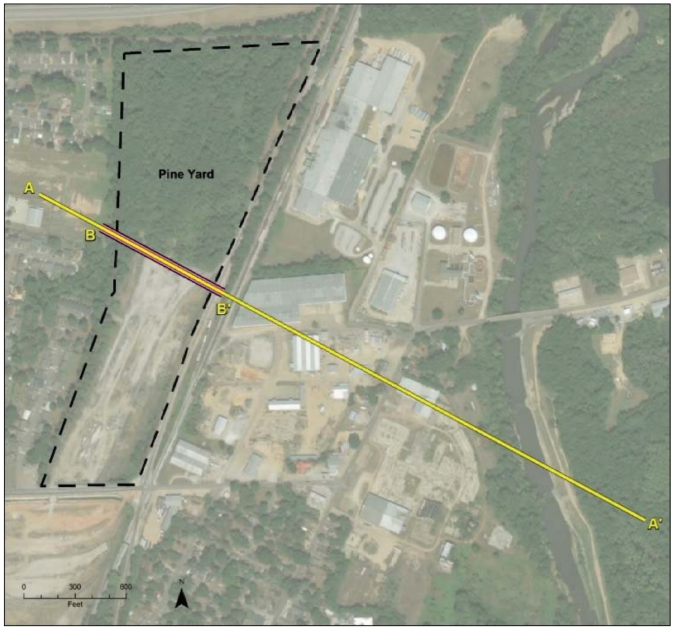
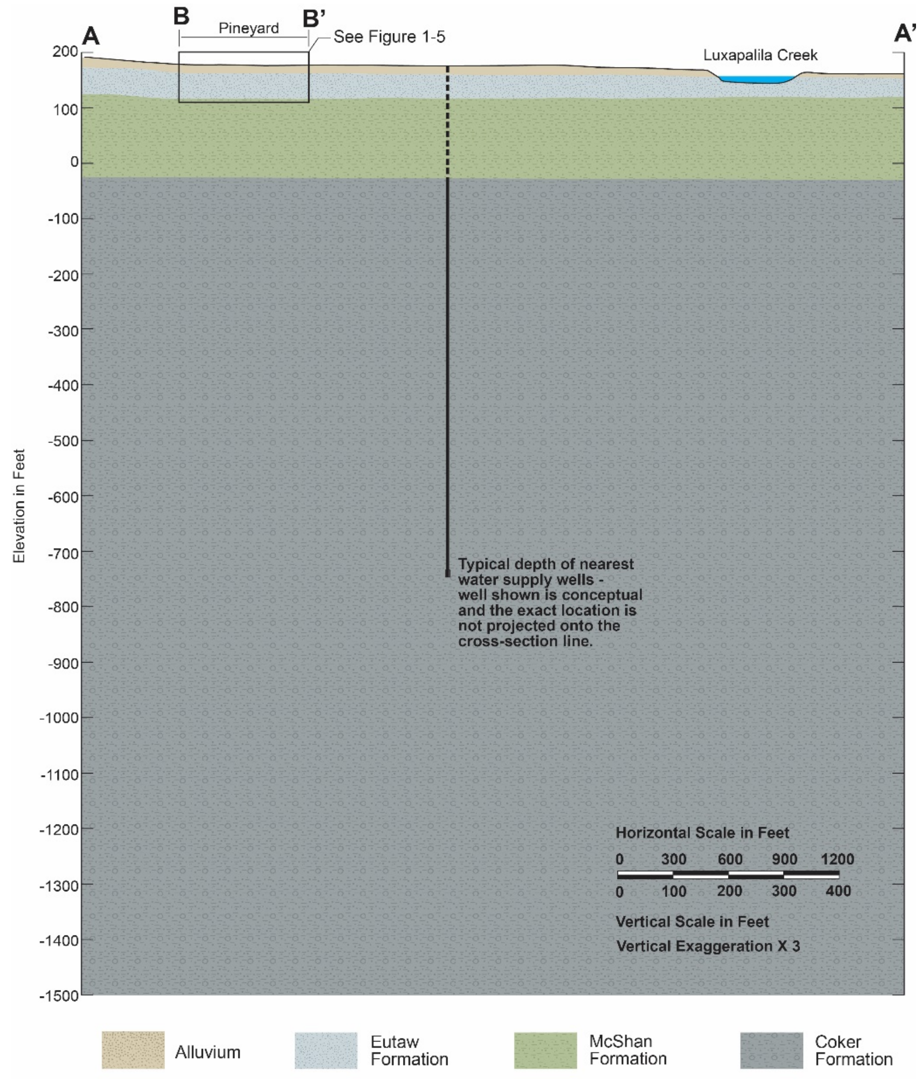
Trustee of the Multistate Environmental
Response Trust

Prepared by: integral consulting inc.

**Figure 1-2.**
Pine Yard Features and Adjoining Properties
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018




8/1/2018

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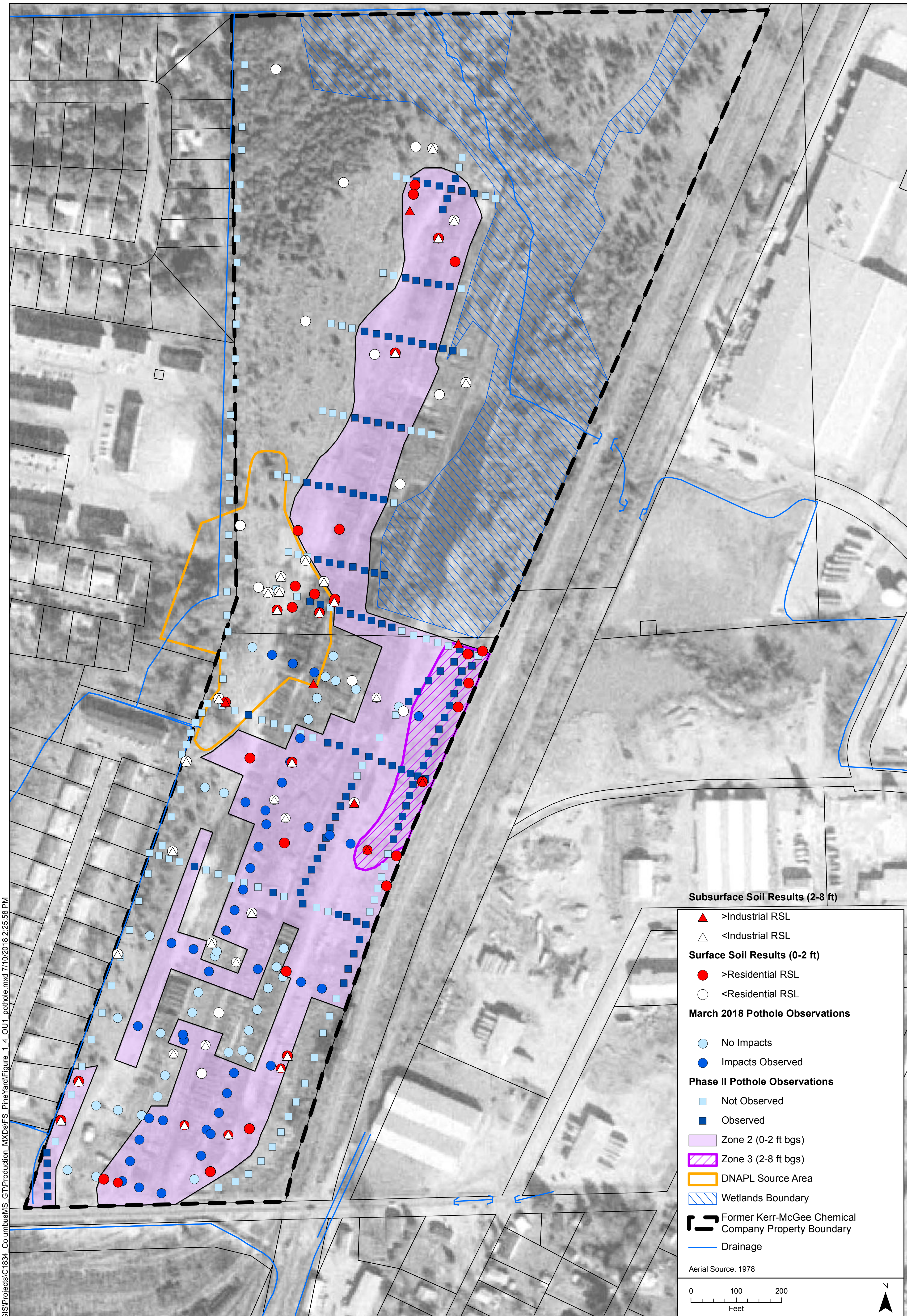
Trustee of the Multistate Environmental Response Trust

Prepared by: integral consulting inc.

**Figure 1-3.**
Pine Yard Hydrogeology
Kerr-McGee Chemical Corp. – Columbus
Focused Feasibility Study Report, OU-1
August 2018

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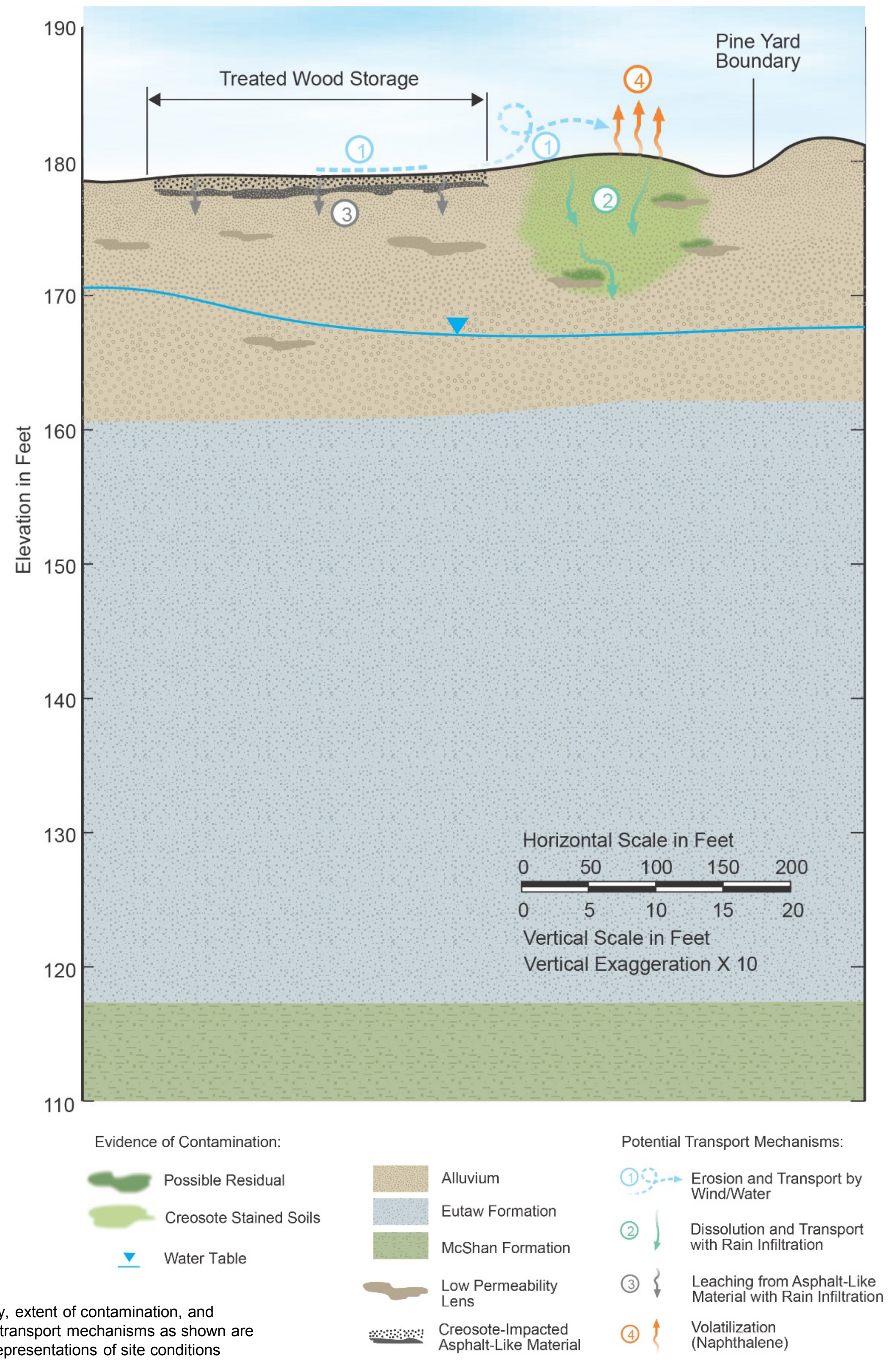
Trustee of the Multistate Environmental Response Trust

Prepared by: integral consulting inc.

**Figure 1-4.**
Estimated Areal Extent of OU-1 Soils
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018




Note:
Hydrogeology, extent of contamination, and contaminant transport mechanisms as shown are conceptual representations of site conditions informed by available data.

8/1/2018

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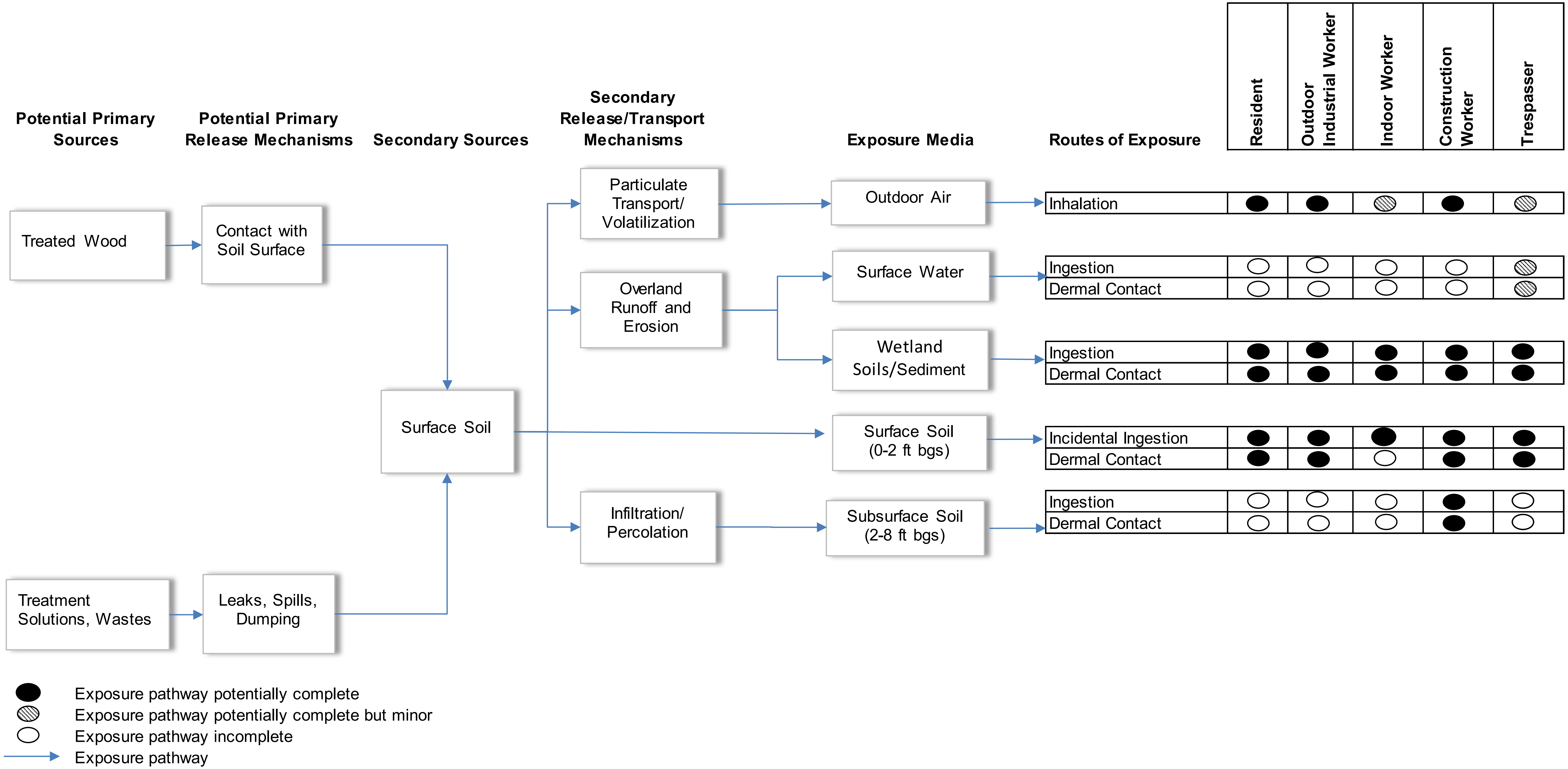
Prepared by: integral consulting inc.

**Figure 1-5.**
Conceptual Site Model of COC Transport Mechanisms for OU-1
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018




8/1/2018

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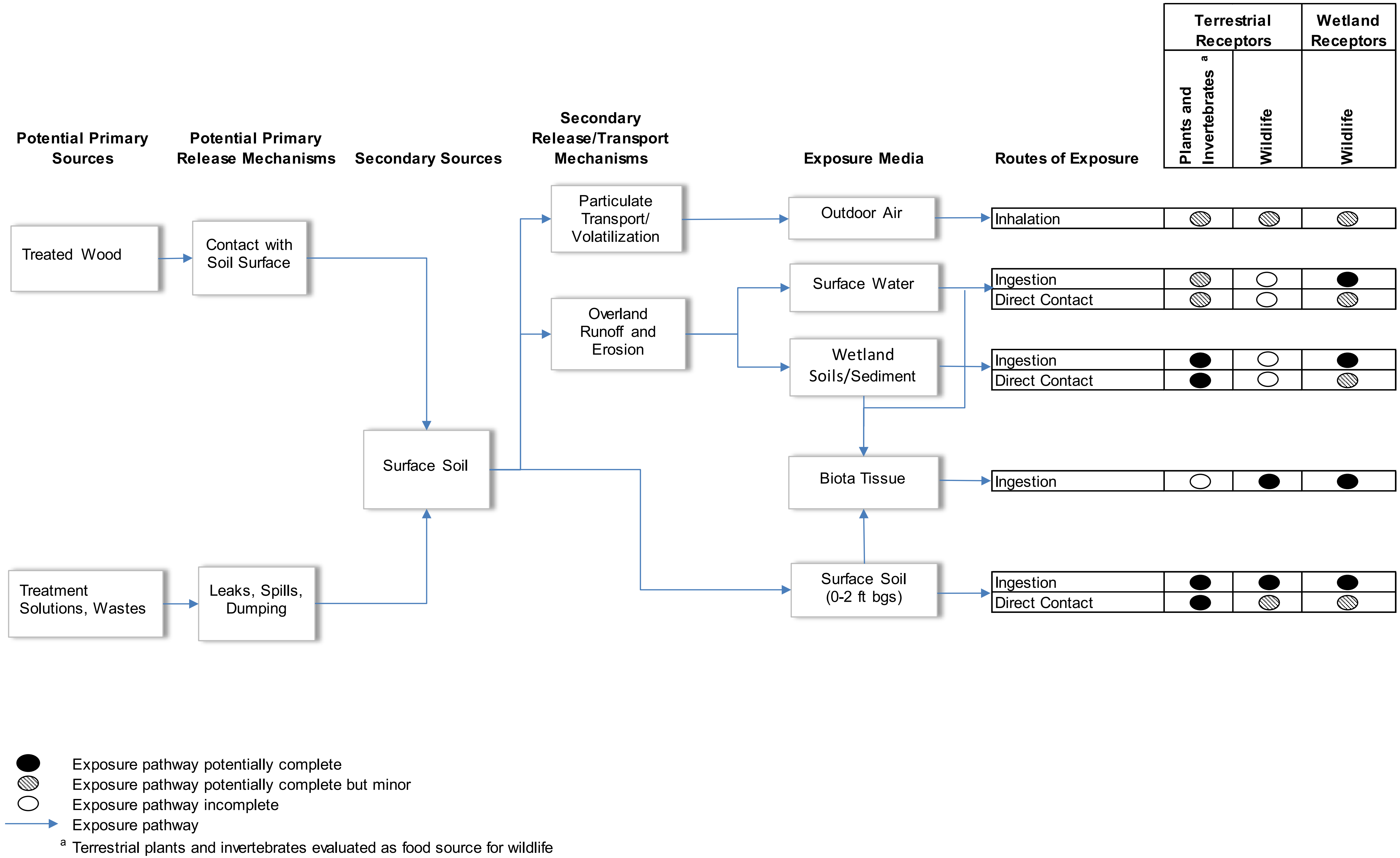
Trustee of the Multistate Environmental Response Trust

Prepared by: integral

**Figure 1-6.**
Conceptual Site Model Illustrating Contaminant Sources, Transport Mechanisms, and Pathways for Human Exposure for OU-1
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018

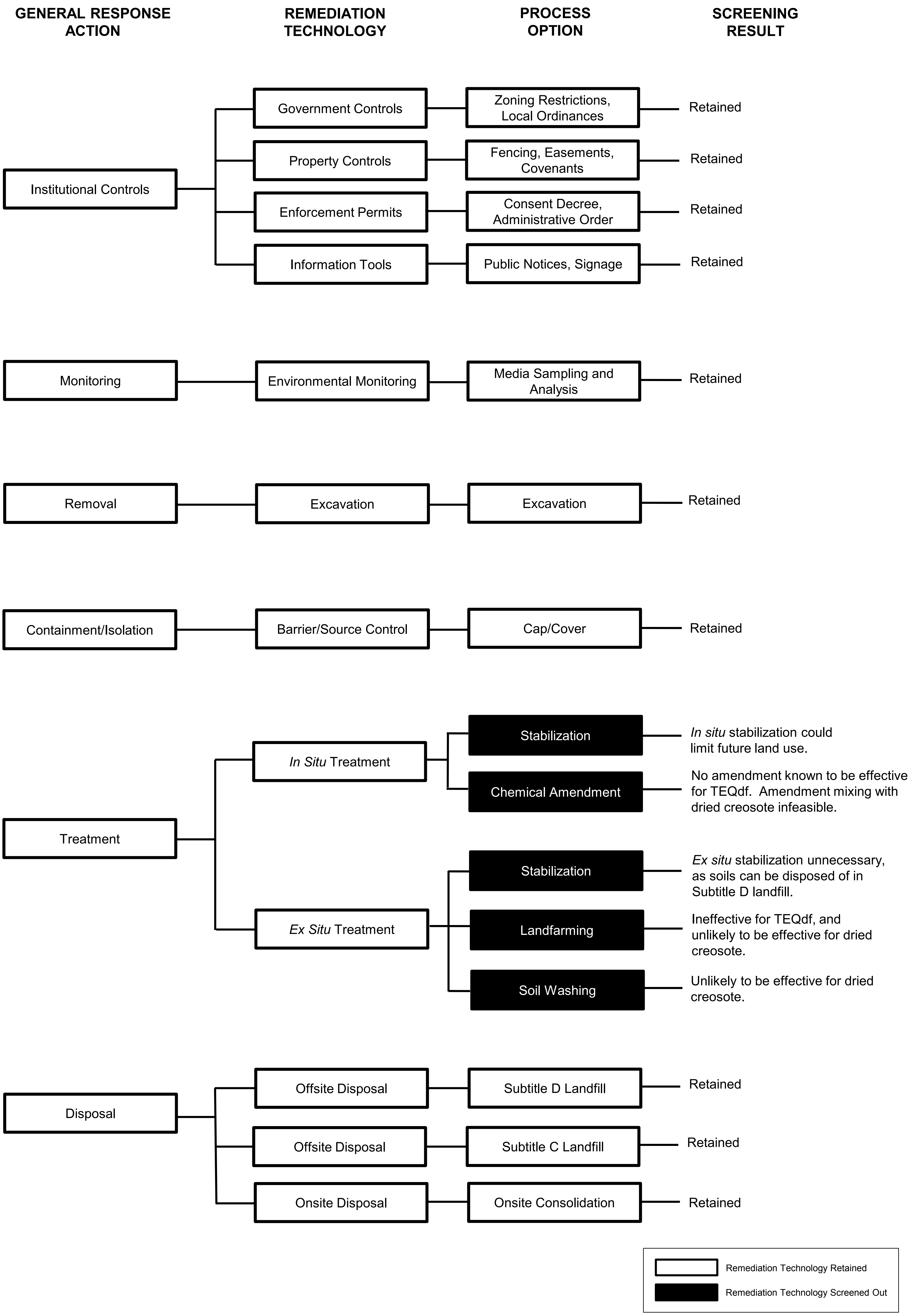



8/1/2018

Prepared for: Greenfield Environmental Trust, LLC
Trustee of the Multistate Environmental Response Trust

Prepared by: integral consulting inc.

**Figure 1-7.**
Conceptual Site Model Illustrating Contaminant Sources, Transport Mechanisms, and Pathways for Ecological Exposure for OU-1
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018




8/1/2018

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Trustee of the Multistate Environmental Response Trust

Prepared by: integral consulting inc.

**Figure 2-1.**
Identification and Screening of Remediation Technologies and Process Options
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018

| | | EVALUATION CRITERIA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Threshold | | Balancing | | | | | Modifying | |
| | | Protectiveness | Compliance with ARARs | Long-Term Effectiveness | Short-Term Effectiveness | Reduction of Toxicity, Mobility, or Volume | Implementability | Cost (millions) | Regulatory Acceptance | Community Acceptance |
| **Alternative 1** | No Action | Very Poor | Very Poor | Very Poor | Fair | Very Poor | Excellent | 0.18 | Very Poor | Very Poor |
| **Alternative 2** | Removal and Offsite Disposal | Excellent | Excellent | Excellent | Poor | Excellent | Excellent | 9.89 | Excellent | Excellent |
| **Alternative 3** | Removal and Onsite Consolidation | Excellent | Excellent | Good | Poor | Good | Good | 6.47 | Good | Fair |
| **Alternative 4** | Cover | Excellent | Excellent | Good | Excellent | Fair | Excellent | 3.14 | Good | Poor |

***LEGEND***

- ● Excellent
- ◕ Good
- ◑ Fair
- ◔ Poor
- ○ Very Poor

8/1/2018

Prepared for: Greenfield Environmental Trust, LLC
Trustee of the Multistate Environmental Response Trust

Prepared by: integral consulting inc.

**Figure 4-1.**
Summary of the Detailed Analysis of Remedial Alternatives
Kerr-McGee Chemical Corp. – Columbus Superfund Site
Columbus, Mississippi
Focused Feasibility Study Report, OU-1
August 2018

# TABLES

Table 1-1. Comparison of Chemical Concentrations in OU-1 Zone 2 Soils to Residential and Industrial Regional Screening Levels

| Chemical | Total Number of Samples | Residential RSL (mg/kg) | Number of Samples in Exceedance of Residential RSL | Industrial RSL (mg/kg) | Number of Samples in Exceedance of Industrial RSL |
|---|---|---|---|---|---|
| **Dioxins and Furans** | | | | | |
| TEQdf | 14 | 4.80E-06 | 8 | 2.20E-05 | 6 |
| **Inorganics** | | | | | |
| Arsenic | 11 | 6.80E-01 | 8 | 3.00E+00 | 7 |
| Chromium | 11 | 3.00E-01 | 11 | 6.30E+00 | 8 |
| **PAHs and SVOCs** | | | | | |
| Benz[*a*]anthracene | 98 | 1.10E+00 | 55 | 2.10E+01 | 19 |
| Benzo[*a*]pyrene | 98 | 1.10E-01 | 67 | 2.10E+00 | 51 |
| Benzo[*b*]fluoranthene | 98 | 1.10E+00 | 63 | 2.10E+01 | 33 |
| Benzo[*k*]fluoranthene | 98 | 1.10E+01 | 26 | 2.10E+02 | 1 |
| Chrysene | 98 | 1.10E+02 | 10 | 2.10E+03 | 0 |
| Dibenz[*a,h*]anthracene | 98 | 1.10E-01 | 58 | 2.10E+00 | 26 |
| Dibenzofuran | 39 | 7.30E+01 | 3 | 1.00E+03 | 0 |
| Fluoranthene | 98 | 2.40E+03 | 2 | 3.00E+04 | 0 |
| Fluorene | 95 | 2.40E+03 | 1 | 3.00E+04 | 0 |
| Indeno[1,2,3-*cd*]pyrene | 98 | 1.10E+00 | 52 | 2.10E+01 | 10 |
| Naphthalene | 98 | 3.80E+00 | 12 | 1.70E+01 | 7 |
| Pyrene | 98 | 1.80E+03 | 2 | 2.30E+04 | 0 |
| Pentachlorophenol | 98 | 1.00E+00 | 33 | 4.00E+00 | 25 |
| **Pesticides** | | | | | |
| Carbazole | 39 | 2.40E+01 | 3 | -- | NA |

Notes:

-- = no RSL available for this chemical

COPC = chemical of potential concern

NA = not applicable

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

RSL = regional screening level, data from USEPA, June, 2017; Regional Screening Level Summary Table. November 2017 RSLs based on a hazard quotient of 1.0 and a cancer risk level of 1E-6 were used.

SVOC = semivolatile organic compound

TEQdf = toxicity equivalent concentrations for dioxins and furans

Table 1-2. Physical and Chemical Properties of OU-1 COCs

| Parameter Name | Koc (mL/g) | Henry's Constant (atm-m$^3$/mol) | Solubility (mg/L) | Boiling Point (°C) | Biodegradation Potential (-) | Vapor Pressure (mm Hg) | Specific Gravity (-) |
|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | |
| Arsenic | 25[a] | N/A | N/A | 603[b] | R | 0.00[c] | 5.75[b] |
| **SVOCs** | | | | | | | |
| Benz[*a*]anthracene | 1.38E+06[d] | 1.16E-06[d] | 5.70E-03[d] | 400[d] | R | 2.20E-08[d] | N/A |
| Benzo[*a*]pyrene | 5.50E+06[d] | 1.55E-06[d] | 1.20E-03[d] | 310[d] | R | 5.60E-09[d] | 1.351[e] |
| Benzo[*b*]fluoranthene | 5.50E+05[d] | 1.19E-02[d] | 1.40E-02[d] | 438[d] | R | 5.00E-07[d] | 0.784[f] |
| Benzo[*k*]fluoranthene | 6.45E+06 to 8.12E+07[g] | 5.84E-07[g] | 7.60E-04[g] | 480[g] | R | 9.65E-10[g] | 0.785[f] |
| Chrysene | 2.00E+05[d] | 1.05E-06[d] | 1.80E-03[d] | 448[d] | N/A | 6.30E-09[d] | 1.27[d] |
| Dibenzo[*a,h*]anthracene | 5.70E+5 to 4.80E+7[g] | 1.40E-07[g] | 2.49E-03[g] | 524[g] | R | 9.55E-10[g] | 1.282[h] |
| Fluoranthene | 38,000[d] | 6.46E-06[d] | 2.06E-01[d] | 384[g] | D | 5.00E-06[d] | 1.252[g] |
| Indeno[1,2,3-*cd*]pyrene | 6.02E+05 to 6.60E+08[g] | 3.48E-07[g] | 1.90E-04[g] | 536[g] | R | 1.25E-10[g] | 1.325[f] |
| Naphthalene | 1,300[d] | 1.15E-03[d] | 3.17E+01[d] | 218[d] | D | 2.30E-01[d] | 1.16[d] |
| Pyrene | 32,300 to 84,000[d] | 5.04E-06[d] | 1.32E-01[d] | 393[d] | D | 2.50E-06[d] | 1.27[d] |
| 2-Methylnaphthalene | 8,500[d] | 3.20E-04[d] | 2.46E+01[g] | 241[g] | N/A | 5.50E-02[g] | 1.325[f] |
| 1,1'-Biphenyl | 1,700[d] | 1.90E-04[d] | 7.48E+00[g] | 256[g] | N/A | 8.93E-03[g] | 1.04[c] |
| **Pesticides** | | | | | | | |
| Carbazole | 1,995[d] | 8.60E-07[d] | 4.00E-01[d] | 355[d] | D | 1.60E-06[d] | 1.10[d] |
| **Phenols** | | | | | | | |
| Pentachlorophenol | 53,000[d] | 2.75E-06[d] | 1.40E+01[d] | 309[d] | D | 1.10E-04[d] | 1.38[d] |
| **Dioxins and Furans** | | | | | | | |
| Dibenzofuran | 4,200[g] | 2.10E-04[g] | 3.10E+00[g] | 287[g] | N/A | 2.48-03[g] | 1.09[g] |
| 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin | 2.45E+07[g] | 3.20E-06[g] | 2.00E-04[g] | 500[g] | R | 6.40E-10[g] | 1.827[f] |

Notes:

COC = chemical of concern
Koc = carbon-water partitioning coefficient
N/A = not applicable
R = Recalcitrant, D = Relatively Degradable
SVOC = semivolatile organic compound

Physical property data are from the following sources:
[a] GSI Environmental Chemical Database, www.gsi-net.com
[b] Physical Constants of Inorganic Compounds, CRC Handbook of Chemistry and Physics, 88th Edition
[c] National Institute for Occupational Safety and Health, NIOSH Pocket Guide to Chemical Hazards, www.cdc.gov
[d] J. Dragun, 1984, A Chemical Engineer's Guide to Groundwater Contamination
[e] Report on Carcinogens, Fourteenth Edition, U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program
[f] Safety Data Sheet, www.restek.com
[g] Pubchem Open Chemistry Database, National Institutes of Health, pubchem.ncbi.nlm.nih.gov
[h] Report on Carcinogens, Twelfth Edition, 2011, U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program

Table 1-3. Summary of Soil COCs by Receptor

| COC | Resident | Outdoor Worker | Indoor Worker | Construction Worker (Surface) | Construction Worker (Subsurface) | Trespasser |
|---|---|---|---|---|---|---|
| TEQdf | **X** | **X** | **X** | **X** | | **X** |
| Benzo[a]pyrene | **X** | **X** | X | **X** | | |
| Benzo[a]anthracene | X | X | X | | | |
| Benzo[b]fluoranthene | X | X | X | | | |
| Benzo[k]fluoranthene | X | | | | | |
| Dibenzo[a,h]anthracene | X | X | X | | | |
| Indeno[1,2,3-cd]pyrene | X | | | | | |
| Dibenzofuran | X | | | | | |
| Chrysene | X | | | | | |
| Fluoranthene | X | | | | | |
| Naphthalene | X | X | | | | |
| Carbazole | X | | | | | |
| Pyrene | X | | | | | |
| 2-Methylnaphthalene | X | | | | | |
| 1,1'-Biphenyl | X | | | | | |
| Pentachlorophenol | X | X | X | | | |
| Arsenic | X | X | X | | | |

Notes:

Bolded Xs indicate chemicals that are primary COCs (≥5% contribution to cumulative risk).

COCs are identified for scenarios with a cumulative ELCR >1E-04 or HI>1.

COC = chemical of concern

ELCR = excess lifetime cancer risk

HI = hazard index

TEQdf = toxicity equivalent concentrations for dioxins and furans

Table 1-4. Summary of Soil COPECs

| |
|---|
| TEQdf - Bird |
| TEQdf - Mammal |
| Cyanide |
| Cadmium |
| Copper |
| Mercury |
| Iron |
| Total High Molecular Weight Polycyclic Aromatic Hydrocarbons |
| Total Low Molecular Weight Polycyclic Aromatic Hydrocarbons |
| Total Polycyclic Aromatic Hydrocarbons |
| 4,4'-DDE |
| Pentachlorophenol |
| Dibenzofuran |
| 3-Methylphenol, 4-Methylphenol |
| 4-Methyl-2-pentanone |

Notes:
COPEC = chemical of potential ecological concern
TEQdf = toxicity equivalent concentrations for dioxins and furans

Table 2-1. Location-Specific ARARs and TBCs

| Location | Requirements | Prerequisite | Citation |
|---|---|---|---|
| **Actions within Floodplain** | | | |
| Presence of Floodplain(s) designated on the FEMA Flood Map[a] | Shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains. | Federal actions that involve potential impacts to, or take place within, floodplains – **TBC** | Executive Order 11988 Section 1. Floodplain Management |
| | Shall consider alternatives to avoid, to the extent possible, adverse effects and incompatible development in the floodplain. Design or modify its action in order to minimize potential harm to or within the floodplain. | | Executive Order 11988 Section 2(a)(2) Floodplain Management |
| | Where possible, an agency shall use natural systems, ecosystem processes, and nature-based approaches when developing alternatives for consideration. | | Executive Order 13690 Section 2.(c) |
| | The Agency shall design or modify its actions so as to minimize[b] harm to or within the floodplain. | Federal *actions affecting or affected by Floodplain* as defined in 44 CFR § 9.4 – **relevant and appropriate** | 44 CFR § 9.11(b)(1) *Mitigation* |
| | The Agency shall restore and preserve natural and beneficial floodplain values. | | 44 CFR § 9.11(b)(3) *Mitigation* |
| | The Agency shall minimize:<br>Potential harm to lives and the investment at risk from base flood, or in the case of critical actions[c], from the 500-year flood;<br>Potential adverse impacts that action may have on floodplain values. | | 44 CFR § 9.11(c)(1) and (3) *Minimization provisions* |
| **Actions within Wetlands** | | | |
| Location encompassing aquatic ecosystem as defined in 40 CFR §230.3(c) | Except as provided under CWA section 404(b)(2), no discharge of dredged or fill material is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the United States. | Action that involves the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands –**relevant and appropriate** | 40 CFR § 230.10(a) and (c) |

Table 2-1. Location-Specific ARARs and TBCs

| Location | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | Except as provided under CWA section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem. 40 CFR § 230.70 *et seq*. identifies such possible steps. | | 40 CFR § 230.10(d) |
| | Must comply with the substantive requirements of the Nation Wide Permit 38, General Conditions, as appropriate.<br><br>*NOTE:* Although permits are not required per CERCLA Section 121(e)(1), consultation with the USACE recommended to determine whether any adverse impacts not covered by the permit that may require mitigation. Such mitigation would be performed as part of the remedial action. | Discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands – **TBC** | Nation Wide Permit (38) Cleanup of Hazardous and Toxic Waste[Ref. 33 CFR § 323.3(b) Requires EPA to obtain authorization under general permit] |

Notes:
FEMA = Federal Emergency Management Agency
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act, as amended
CFR = Code of Federal Regulations
CWA = Clean Water Act of 1972, as amended
TBC = To Be Considered guidance
USACE = United States Army Corps of Engineers

[a] Under 44 CFR § 9.7 ***Determination of proposed action's location***, Paragraph (c) *Floodplain determination*. One should consult the FEMA Flood Insurance Rate Map (FIRM), the Flood Boundary Floodway Map (FBFM) and the Flood Insurance Study (FIS) to determine if the Agency proposed action is within the base floodplain.

[b] *Minimize* means to reduce to smallest amount or degree possible. 44 CFR § 9.4 Definitions.

[c] See 44 CFR § 9.4 Definitions, *Critical action*. Critical actions include, but are not limited to, those which create or extend the useful life of structures or facilities such as those that produce, use or store highly volatile, flammable, explosive, toxic or water-reactive materials.

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| **General Construction Standards – All Land Disturbing Activities** | | | |
| Activities causing storm water runoff (e.g., clearing, grading, excavation) | Implement good construction management techniques in accordance with the substantive requirements for permits issued pursuant to 40 CFR § 122.26(c) – storm water discharges associated with industrial activity <u>or</u> under a General Permit.<br>NOTE: Permits are not required under CERCLA Section 121(e)(1). Substantive requirements that otherwise included in a permit will be identified in Remedial Action Work Plan. | Dewatering or storm water discharges associated with construction activity disturbing one or more acres as defined in 40 CFR 122.26(b)(15) – **applicable** | 40 CFR Part § 122.26(c)(1) |
| | Shall provide a narrative description of:<br>(A) The location (including a map) and the nature of the construction activity;<br>(B) The total area of the site and the area of the site that is expected to undergo excavation;<br>(C) Proposed measures, including BMPs to control stormwater discharges during construction, including a brief description of applicable State and local erosion and sediment control requirements;<br>(D) Proposed measures to control pollutants in storm water discharges that will occur after construction operations have been completed, including a brief description of applicable State or local erosion and sediment control requirements;<br>(E) Estimate of the runoff coefficient of the site and the increase in impervious area after the construction is completed, the nature of fill material and existing data describing the soil or the quality of the discharge; and<br>(F) The name of the receiving water. | | 40 CFR Part § 122.26(c)(1)(ii) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Activities causing storm water runoff (e.g., clearing, grading, excavation) *cont.* | You must design, install, and maintain stormwater controls required in Parts 2.2 and 2.3 to minimize the discharge of pollutants in stormwater from construction activities.<br>Must develop a Storm Water Pollution Prevention Plan (SWPPP) consistent with the requirements in Part 7 in the EPA 2017 Construction General Permit.<br>*NOTE*: Under CERCLA 121(e)(1) permits are not required for on-site response actions. However, compliance with the substantive requirements in the EPA 2107 Construction General Permit (determined to be TBC) is recommended to ensure management of stormwater in order to prevent erosion or unauthorized discharges. | Dewatering or storm water discharges associated with construction activity disturbing one or more acres as defined in 40 CFR 122.26(b)(15) – **TBC** | 2017 EPA NPDES General Permit for Discharges from Construction Activities<br>https://www.epa.gov/npdes/epas-2017-construction-general-permit-cgp-and-related-documents |
| Activities causing fugitive dust emissions | Shall not cause, allow, or permit the emission of particles, or any contaminants in sufficient amounts or of such duration from any process as to be injurious to humans, animals, plants, or property, or to create a condition of air pollution. | Fugitive emissions from construction operations, grading, or the clearing of land – **applicable** | MDEQ Regulation APC-S-1, Section 3, Paragraph 3 |
| **Waste Generation, Characterization–Primary waste (excavated soils,) and Secondary wastes (e.g., contaminated equipment, PPE) [a]** | | | |
| Characterization of ***solid waste*** (all primary and secondary wastes) | Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR § 261.4; and<br>Must determine if waste is listed as a hazardous waste under 40 CFR Part 261. | Generation of solid waste as defined in 40 CFR § 261.2 – **applicable** | 40 CFR § 262.11(a) and (b) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | Must determine whether the waste is (characteristic waste) identified in subpart C of 40 CFR part 261by either:<br>• Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or<br>• Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used. | | 40 CFR § 262.11(c)(1) and (2) |
| | Must refer to 40 CFR Parts 261, 262, 264, 265, 266, 268, and 273 for possible exclusions or restrictions pertaining to management of the specific waste. | Generation of solid waste that is determined to be hazardous – **applicable** | 40 CFR § 262.11(d) |
| Characterization of ***hazardous waste*** (all primary and secondary wastes) | Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR §§ 264 and 268 | Generation of RCRA hazardous waste for storage, treatment, or disposal – **applicable** | 40 CFR § 264.13(a)(1) |
| Determinations for management of hazardous waste | Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 *et seq.*.<br>This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter.<br>*NOTE:* For purposes of part 268, the waste will carry the code any applicable listed waste (40 CFR 261, subpart D). In addition, where the waste exhibits a characteristic, the wastes will carry one or more characteristic codes (40 CFR 261, subpart C). | Generation of RCRA hazardous waste for storage, treatment, or disposal – **applicable** | 40 CFR § 268.9(a) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste. | Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal –**applicable** | 40 CFR § 268.9(a) |
| | A generator of hazardous waste must determine if the waste has to be treated before it can be disposed. This is done by determining if the hazardous waste meets the treatment standards in 40 *CFR* 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste.<br><br>*NOTE:* This determination can be made concurrently with the hazardous waste determination required in 40 CFR 262.11. | Generation of hazardous waste for storage, treatment or disposal – **applicable** | 40 CFR § 268.7(a) |
| Characterization of remediation wastes | Obtain a detailed chemical and physical analysis of a representative sample of the hazardous remediation wastes to be managed at the site. At a minimum, the analysis must contain all of the information which must be known to treat, store or dispose of the waste according to this part and part 268 of this chapter and must be kept up to date. | Management of remediation wastes at facility that does not have a RCRA permit – **applicable** | 40 CFR § 264.1(j)(2) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| **Waste Storage – Primary waste (excavated soils) and Secondary wastes (e.g., contaminated equipment, PPE) [b]** | | | |
| Temporary on-site storage of hazardous waste in containers | A generator may accumulate hazardous waste at the facility provided that: | Accumulation of RCRA hazardous waste on-site as defined in 40 CFR § 260.10 – **applicable** | 40 CFR § 262.34(a); |
| | • waste is placed in containers that comply with 40 CFR §§ 265.171-173; and | | 40 CFR § 262.34(a)(1)(i) |
| | • the date upon which accumulation begins is clearly marked and visible for inspection on each container; | | 40 CFR § 262.34(a)(2) and (3) |
| | • container is marked with the words "hazardous waste" or | | |
| | • container may be marked with other words that identify contents | Accumulation of 55 gals. or less of RCRA hazardous waste or 1 qrt. Of acutely hazardous waste at or near any point of generation – **applicable** | 40 CFR § 262.34(c)(1) |
| Use and management of hazardous waste in containers | If container is not in good condition or if it begins to leak, must transfer waste into container in good condition | Storage of RCRA hazardous waste in containers – **applicable** | 40 CFR § 265.171 |
| | Use container made with lined materials compatible with waste to be stored so that the ability of the container is not impaired | | 40 CFR § 265.172 |
| | Keep containers closed during storage, except to add/remove waste | | 40 CFR § 265.173(a) |
| | Open, handle, and store containers in a manner that will not cause containers to rupture or leak | | 40 CFR § 265.173(b) |
| Storage of hazardous waste in a container area | Area must have a containment system designed and operated in accordance with 40 CFR § 264.175(b) | Storage of RCRA hazardous waste in containers *with free liquids* – **applicable** | 40 CFR § 264.175(a) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or<br>Containers must be elevated or otherwise protected from contact with accumulated liquid | Storage of RCRA hazardous waste in containers that do not contain free liquids (other than F021, F022, F023, F026 and F027) – **applicable** | 40 CFR § 264.175(c) |
| Closure performance standard for RCRA container storage unit | Must close the facility (e.g., container storage unit) in a manner that:<br>• minimizes the need for further maintenance;<br>• controls, minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or the atmosphere; and<br>• complies with the closure requirements of subpart, but not limited to, the requirements of 40 CFR § 264.178 for containers. | Storage of RCRA hazardous waste in containers – **applicable** | 40 CFR §264.111 |
| Closure of RCRA container storage unit | At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed.<br>[Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate in accordance with 40 CFR § 261.3(d) of this chapter that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262 through 266 of this chapter]. | Storage of RCRA hazardous waste in containers in a unit with a containment system – **applicable** | 40 CFR §264.178 |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Designation of a CAMU | To implement remedies under § 264.101 or RCRA Section 3008(h), or to implement remedies at a permitted facility that is not subject to § 264.101, the Regional Administrator may designate an area at the facility as a corrective action management unit under the requirements in this section.<br><br>CAMUs means an area within a facility that is used only for managing CAMU-eligible wastes for implementing corrective action or cleanup at the facility. A CAMU must be located within the contiguous property under the control of the owner or operator where the wastes to be managed in the CAMU originated. One or more CAMUs may be designated at a facility.<br><br>*NOTE:* Designation of a CAMU will be documented in a CERCLA decision document [i.e., Record of Decision (ROD), ROD amendment, or explanation of significant differences (ESD)]<br><br>. | Management of CAMU-eligible wastes within a CAMU – **applicable** | 40 CFR § 264.552(a) |
| | *CAMU-eligible waste* means: All solid and hazardous wastes, and all media (including ground water, surface water, soils, and sediments) and debris that are managed for implementing cleanup. As-generated wastes (either hazardous or non-hazardous) from ongoing industrial operations at a site are not CAMU-eligible wastes. | | 40 CFR § 264.552(a)(1)(i) |
| CAMU for storage | CAMUs used for storage and/or treatment only are CAMUs in which wastes will not remain after closure. Such CAMUs must be designated in accordance with all of the requirements of this section, except as follows. | Management of CAMU-eligible wastes within a CAMU used for storage and/or treatment only – **applicable** | 40 CFR § 264.552(f) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | CAMUs that are used for storage and/or treatment only and that operate in accordance with the time limits established in the staging pile regulations at §264.554(d)(1)(iii), (h), and (i) are subject to the requirements for staging piles at §264.554(d)(1)(i) and (ii), §264.554(d)(2), §264.554(e) and (f), and §264.554(j) and (k) in lieu of performance standards and requirements for CAMUs in this section at paragraphs (c) and (e)(3) through (6). | | 40 CFR § 264.552(f)(1) |
| Temporary on-site storage of remediation waste in staging piles (e.g., excavated soils) | Must be located within the contiguous property under the control of the owner/operator where the wastes are to be managed in the staging pile originated. | Accumulation of *non-flowing hazardous remediation waste* (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR § 260.10 – **applicable** | 40 CFR § 264.554(a)(1) |
| Temporary on-site storage of remediation waste in staging piles (e.g., excavated soils) | May be temporarily stored (including mixing, sizing, blending, or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility if used only during remedial operations provided that the staging pile:<br>• must facilitate a reliable, effective, and protective remedy;<br>• must be designed to prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer as necessary to protect human health and the environment (e.g., use of liners, covers, run-off/run-on controls) | | 40 CFR § 264.554(a)(1)(i) and (ii) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Operation of a staging pile | The staging pile must not operate for more than two years, except when the EPA or Director grants an operating term extension under 40 CFR § 264.554(i).<br><br>*NOTE:* Must measure the 2-year limit (or other operating term specified) from first time remediation waste placed in staging pile. | Accumulation of *non-flowing hazardous remediation waste* (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR § 260.10 – **applicable** | 40 CFR §§ 264.554(d)(1)(iii) |
| | The EPA or Director may allow a staging pile to operate for up to two years after the hazardous waste is first placed into the pile. Must not use staging pile longer than the length of time designated by the Director in the permit, closure plan, or order ("operating term"), except as provided in paragraph (i) of this section.<br>*NOTE:* Additional time limits for storage will be justified and documented in a ROD, ROD Amendment or ESD issued by EPA. | Accumulation of *non-flowing hazardous remediation waste* (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR § 260.10 – **applicable** | 40 CFR §264.554(h) |
| | The EPA or Director may grant one operating term extension of up to 180 days beyond the operating term limit contained in the permit, closure plan, or order. To justify to the Director the need for the extension, you must provide sufficient and accurate information to enable the Director to determine that continued use of the staging plie:<br>(i) Will not pose a threat to human health and the environment; and<br>(ii) Is necessary to ensure timely and efficient implementation of the remedial actions at the facility. | | 40 CFR §264.554(h)(i)(1) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Temporary on-site storage of remediation waste in staging piles (e.g., excavated soils) | In setting standards and design criteria, must consider the following factors:<br>• length of time pile will be in operation;<br>• volumes of waste intended to store in pile;<br>• physical and chemical characteristics of waste to be stored in unit<br>• potential for releases from the unit hydrogeological and other relevant environmental conditions at the facility that may influence the migration of any potential releases; and<br>• potential for human and environmental exposure to potential releases from the unit | Accumulation of *non-flowing hazardous remediation waste* (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR § 260.10 – **applicable** | 40 CFR § 264.554(d)(2)(i)-(vi) |
| Temporary on-site storage of remediation waste in staging piles (e.g., excavated soils) | Must not place ignitable or reactive remediation waste in a staging pile unless the remediation waste has been treated, rendered, or mixed before placed in the staging pile so that: | Storage of “ignitable” or “reactive” remediation waste in staging pile – **applicable** | 40 CFR § 264.554(e) |
| | • the remediation waste no longer meets the definition of ignitable or reactive under 40 CFR 261.21 or 40 CFR 261.23; and | | 40 CFR § 264.554(e)(1)(i) |
| | • you have complied with 40 CFR 264.17(b); or | | 40 CFR § 264.554(e)(1)(ii) |
| | Must manage the remediation waste to protect it from exposure to any material or condition that may cause it to ignite or react. | | 40 CFR § 264.554(e)(2) |
| | Must not place in the same staging pile unless you have complied with 40 CFR 264.17(b). | Storage of ”incompatible” remediation waste (as defined in 40 CFR 260.10) in staging pile – **applicable** | 40 CFR § 264.554(f)(1) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | Must separate the incompatible waste of materials, or protect them from one another using a dike, berm, wall, or other device. | Staging pile of remediation waste stored nearby to incompatible wastes or materials in containers, other piles, open tanks or land disposal units – **applicable** | 40 CFR § 264.554(f)(2) |
| | Must not pile remediation waste on same base where incompatible wastes or materials were previously piled unless the base has been sufficiently decontaminated in compliance with 40 CFR § 264.17(b) | | 40 CFR § 264.554(f)(3) |
| Closure of staging pile of remediation waste | Must be closed within 180 days after the operating term by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate. | Storage of remediation waste in staging pile in *previously contaminated area* – **applicable** | 40 CFR § 264.554(j)(1) |
| | Must decontaminate contaminated sub-soils in a manner that EPA determines will protect human health and the environment. | | 40 CFR § 264.554(j)(2) |
| | Must be closed within 180 days after the operating term according to 40 CFR §§ 264.258(a) and 264.111 or 265.258(a) and 265.111. | Storage of remediation waste in staging pile *in uncontaminated area* – **applicable** | 40 CFR § 264.554(k) |
| **Waste Treatment and Disposal – Primary waste (e.g., excavated soils) and Secondary wastes (e.g., contaminated equipment, PPE) [c]** | | | |
| Disposal of RCRA hazardous waste in land-based unit | May be land disposed if it meets the requirements in the table “Treatment Standards for Hazardous Waste” at 40 CFR § 268.40 before land disposal. | Land disposal, as defined in 40 CFR § 268.2, of restricted RCRA waste – **applicable** | 40 CFR § 268.40(a) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | All underlying hazardous constituents [as defined in 40 CFR § 268.2(i)] must meet the Universal Treatment Standards, found in 40 CFR § 268.48 Table UTS prior to land disposal. | Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **applicable** | 40 CFR § 268.40(e) |
| Disposal of RCRA hazardous waste soil in a land-based unit | Must be treated according to the alternative treatment standards of 40 CFR § 268.49(c) <u>or</u> according to the UTSs specified in 40 *CFR* § 268.48 applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal. | Land disposal, as defined in 40 *CFR* § 268.2, of restricted hazardous soils – **applicable** | 40 CFR § 268.49(b) |
| Disposal of RCRA hazardous debris in a land-based unit | Must be treated prior to land disposal as provided in 40 CFR § 268.45(a)(1)-(5) unless EPA determines under 40 CFR § 261.3(f)(2) that the debris no longer contaminated with hazardous waste <u>or</u> the debris is treated to the waste-specific treatment standard provided in 40 *CFR* § 268.40 for the waste contaminating the debris. | Land disposal, as defined in 40 *CFR* § 268.2, of RCRA-hazardous debris –**applicable** | 40 CFR § 268.45(a) |
| Disposal of RCRA characteristic wastewaters in a CWA wastewater treatment unit | Are not prohibited, if the wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under 402 the CWA (i.e., NPDES permitted), unless the wastes are subject to a specified method of treatment other than DEACT in 40 CFR §268.40, or are D003 reactive cyanide. | Land disposal of RCRA restricted hazardous wastewaters that hazardous only because they exhibit a characteristic and are not otherwise prohibited under 40 CFR §268 – **applicable** | 40 CFR § 268.1(c)(4)(i) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| **Capping Contaminated Soil/Waste-In-Place** | | | |
| Capping soil contaminated with RCRA hazardous waste | The owner or operator must close the facility in a manner that:<br>(a) minimizes the need for further maintenance;<br>(b) controls minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or the atmosphere.<br>NOTE: Capped area is considered “landfill unit” or “facility” for purposes meeting closure performance standards. | Closure of units with hazardous waste remaining in place – **relevant and appropriate** | 40 CFR § 264.111(a) and (b) |
| Installation of low-permeability cover | Must cover the landfill (or cell) with a final cover designed and constructed to:<br>(1) provide long-term minimization of migration of liquids through the closed landfill;<br>(2) function with minimum maintenance;<br>(3) promote drainage and minimize erosion or abrasion of the cover;<br>(4) accommodate settling and subsidence so that the cover's integrity is maintained; and<br>(5) have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. | Closure of RCRA hazardous waste landfill – **relevant and appropriate** | 40 CFR § 264.310(a) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| | This guidance provides an overview on design, construction and evaluation requirements for various components of and materials used in a final cover (e.g., geomembrane, drainage layer, soil cover, material quality for base layer, etc.) for a several types of landfills including RCRA Subtitle C land disposal facilities. This information can be considered in designing and constructing a final cover that meets the regulatory requirements specified in the RCRA regulations for design, construction and performance of a final landfill cover. | Design and construction of a cover for disposal units with RCRA hazardous waste remaining in place – **TBC** | EPA Seminar Publication<br>*Design and Construction of RCRA/CERCLA Final Covers*, EPA 625 4-91/025 (May 1991) |
| Installation of final landfill cover | Owners must install a final cover system that is designed to minimized infiltration and erosion. The final cover system must be comprised of an erosion layer underlain by an infiltration layer as follows:<br>(1) The infiltration layer must be comprised of a minimum of 18 inches of earthen material that has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10-5 cm/sec, whichever is less, and<br>(2) The erosion layer must consist of a minimum of 6 inches of earthen material that is capable of sustaining native plant growth. | Closure of MSWLF units and all other landfills with industrial solid waste – **relevant and appropriate** | MDEQ Rule 1.4 Landfill Requirements<br>E. (2) (a)<br>Closure Requirements |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Installation of final landfill cover | The Department may approve an alternative final cover design that includes:<br>(1) an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraph E.2.a.(1) of this rule, and<br>(2) an erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph E.2.a.(2) of this rule.<br>*NOTE*: Any approval of an alternative cover will be made by EPA in CERCLA Remedial Action Work Plan. | Closure of MSWLF units and all other landfills with industrial solid waste – **relevant and appropriate** | MDEQ Rule 1.4 Landfill Requirements<br>E. (2) (b)<br>Closure Requirements<br>Alternative Cover |
| | The final cover gradient on landfills that receive waste on or after the effective date of these regulations shall be a minimum of four percent (4%) and a maximum of twenty-five percent (25%), unless otherwise approved by the Department.<br>The final cover gradient on MSWLF units that stop receiving waste before the effective date of these regulations shall not exceed twenty-five percent (25%), unless otherwise approved by the Department.<br>*NOTE*: Any approval of an alternative final cover gradient will be made by EPA in CERCLA Remedial Action Work Plan. | Closure of MSWLF units and all other landfills with industrial solid waste – **relevant and appropriate** | MDEQ Rule 1.4 Landfill Requirements<br>E. (2)(c) and (d) |
| | A native grass seed or other shallow-rooted vegetation suitable to minimize soil erosion, as approved by the Department, must be planted and maintained over each closed unit. Trees may not be used in lieu of or in addition to the grass cover. | | MDEQ Rule 1.4 Landfill Requirements<br>E. (2)(e) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Post-closure Deed Notice for closed landfill | Within ninety (90) days after all landfill units are closed, the owner must record on the deed to the landfill facility property, or some other instrument that is normally examined during title search, a notation and survey plat, prepared by a registered land surveyor, indicating the location and dimensions of the actual filled area with respect to permanently surveyed benchmarks or Section corners, and notify the Department that the notation and survey plat have been recorded and a copy of each has been placed in the operating record.<br>*NOTE*: Capped area is considered "landfill unit" for purposes of including location and dimensions on a survey plat. | Closure of MSWLF units and all other landfills with industrial solid waste – **relevant and appropriate** | MDEQ Rule 1.4 Landfill Requirements E. (2)(g)(1) |
| | The notation on the deed must in perpetuity notify any potential purchaser of the property of the following information:<br>(i) the land has been used as a landfill facility;<br>(ii) the name of the landfill owner(s);<br>(iii) the year the landfill started and ended disposal operations; and<br>(iv) its use is restricted under paragraph E.1.a.(7) of this rule. | | MDEQ Rule 1.4 Landfill Requirements E. (2)(g)(2) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Post-closure care of landfill with industrial solid waste | The owner must conduct post-closure care. Post-closure care must be conducted for 30 years, except as provided under paragraph E.3.b of this rule.<br><br>The length of the post-closure care period may be:<br>(1) decreased by the Department if the owner demonstrates that the reduced period is sufficient to protect human health and the environment and this demonstration is approved by the Department; or<br>(2) increased by the Department if the Department determines that the lengthened period is necessary to protect human health and the environment.<br>*NOTE*: Any adjustment to the length for post-closure care will be determined by EPA as part of the CERCLA Removal Action. | Closure of MSWLF units and all other landfills with industrial solid waste – **relevant and appropriate** | MDEQ Rule 1.4 Landfill Requirements<br>E. (3) Post-closure Requirements<br>(a) and (b) |
| Post-closure care of landfill with industrial solid waste | Post-closure care must consist of at least the following:<br>(1) maintaining the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, preventing run-on and run-off from eroding or otherwise damaging the final cover, and preventing the growth of trees on the landfill cover. | Closure of MSWLF units and all other landfills with industrial solid waste – **relevant and appropriate** | MDEQ Rule 1.4 Landfill Requirements<br>E. (3) Post-closure Requirements<br>(c)(1) |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| **Waste Transportation** | | | |
| Transportation of hazardous waste *on-site* | The generator manifesting requirements of 40 CFR § 262.20-262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR § 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way. | Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way – **applicable** | 40 CFR § 262.20(f) |
| Transportation of hazardous waste *off-site* | Must comply with the generator requirements of 40 CFR § 262.20-262.23 for manifesting, § 262.30 for packaging, § 262.31 for labeling, § 262.32 for marking, § 262.33 for placarding, §§ 262.40 and 262.41(a) for record keeping requirements, and § 262.12 to obtain EPA ID number. | Preparation and initiation of shipment of RCRA hazardous waste off-site – **applicable** | 40 CFR § 262.10(h) |
| Transportation of waste samples | Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: | Samples of solid waste <u>or</u> a sample of water, soil for purpose of conducting testing to determine its characteristics or composition – **applicable** | 40 CFR §261.4(d)(1) |
| | • the sample is being transported to a laboratory for the purpose of testing; or | | 40 CFR §261.4(d)(1)((i) |
| | • the sample is being transported back to the sample collector after testing. | | 40 CFR §261.4(d)(1)(ii) |
| | In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: | | 40 CFR §261.4(d)(2)(i) |
| | • Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements. | | 40 CFR §261.4(d)(2)(i)(A) |
| | • Assure that the information provided in (1) thru (5) of this section accompanies the sample. | | 40 CFR §261.4(d)(2)(i)(B) |
| | • Package the sample so that it does not leak, spill, or vaporize from its packaging. | | |

Table 2-2. Action-Specific ARARs and TBCs

| Action | Requirements | Prerequisite | Citation |
|---|---|---|---|
| Transportation of hazardous materials | Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR §§ 171-180 related to marking, labeling, placarding, packaging, emergency response, etc. | Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material – **applicable** | 49 CFR § 171.1(c) |

Notes:
ARAR = applicable or relevant and appropriate requirement
EPA = Environmental Protection Agency
CFR = Code of Federal Regulations
CWA = Clean Water Act of 1972
DEACT = deactivation
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
HMR = Hazardous Materials Regulations
HMTA = Hazardous Materials Transportation Act
MDEQ = Mississippi Department of Environmental Quality
NPDES = National Pollution Discharge Elimination System
PPE = personal protection equipment
RCRA = Resource Conservation and Recovery Act of 1976
TBC = To Be Considered guidance
UTS = Universal Treatment Standard

[a] The State of Mississippi incorporates by reference the federal regulations governing hazardous waste generation, characterization, segregation, and storage. See MDEQ Regulations HW-1 (Sept. 29, 2008). Accordingly, only the federal regulations are cited in this table.

[b] The State of Mississippi incorporates by reference the federal regulations governing waste generation, characterization, segregation, and storage. See MDEQ Regulations HW-1 (Sept. 29, 2008). Accordingly, only the federal regulations are cited in this table.

[c] The State of Mississippi incorporates by reference the federal regulations governing land disposal restrictions. See MDEQ Regulations HW-1 (Sept. 29, 2008). Accordingly, only the federal regulations are cited in this table.

Table 2-3. Surface Soil COCs and RALs for Residential and Industrial/Commercial Land Use

| | Residential | | Industrial/Commercial | |
|---|---|---|---|---|
| COC | RAL (mg/kg) | Basis | RAL (mg/kg) | Basis |
| TEQdf | 5.0E-05 | nc | 2.3E-04 | nc |
| Benzo[*a*]pyrene | 1.1E-01 | c | 2.1E+01 | c |
| Benz[*a*]anthracene | 1.1E+00 | c | 2.1E+02 | c |
| Benzo[*b*]fluoranthene | 1.1E+00 | c | 2.1E+02 | c |
| Benzo[*k*]fluoranthene | 1.1E+01 | c | -- | -- |
| Dibenz[*a,h*]anthracene | 1.1E-01 | c | 2.1E+01 | c |
| Indeno[1,2,3-*cd*]pyrene | 1.1E+00 | c | -- | -- |
| Dibenzofuran | 7.3E+01 | nc | -- | -- |
| Chrysene | 1.1E+02 | c | -- | -- |
| Fluoranthene | 2.4E+03 | nc | -- | -- |
| Naphthalene | 3.8E+00 | c | 1.7E+02 | c |
| Carbazole | 2.4E+01 | c | -- | -- |
| Pyrene | 1.8E+03 | nc | -- | -- |
| 2-Methylnaphthalene | 2.4E+02 | nc | -- | -- |
| 1,1'-Biphenyl | 4.7E+01 | nc | -- | -- |
| Pentachlorophenol | 1.0E+00 | c | 4.0E+01 | c |
| Arsenic | 8.70E+00 | b | 8.70E+00 | b |

Notes:

Cancer RALs are based on a target excess lifetime cancer risk of $1 \times 10^{-6}$. Noncancer RALs are based on a target hazard index of 1.

For non-residential soil, the lower of the industrial/commercial and construction worker RALs are shown.

-- = chemical is not a COC under industrial/commercial land use scenario
b = background
c = cancer basis
nc = noncancer basis
COC = chemical of concern
RAL = removal action level
TBD = to be determined
TEQdf = toxicity equivalent concentrations for dioxins and furans

Table 4-1. Detailed Analysis of Remediation Alternatives — Threshold Criteria

| Criteria | Alternative 1 *No Action* | Alternative 2 *Removal and Offsite Disposal* | Alternative 3 *Removal and Onsite Consolidation* | Alternative 4 *Cover* |
|---|---|---|---|---|
| **Overall Protection of Human Health and the Environment** | | | | |
| RAO: Prevent unacceptable risk to human receptors from exposure to soil with concentrations of COPCs above health-based cleanup goals. | Would not achieve the RAO.<br><br>Would leave the site in the present condition which poses an unacceptable risk to potential receptors under future site uses. | Would achieve the RAO through removal of soils that contain COPCs at levels exceeding conservative levels protective of health | Would achieve the RAO through removal of soils that contain COPCs at levels exceeding conservative levels protective of health | Would achieve the RAO through isolation of soils that contain COPCs at levels exceeding conservative levels protective of health |
| **Compliance with ARARs** | | | | |
| Chemical-Specific ARARs | Not applicable. No chemical-specific ARARs identified. | Not applicable. No chemical-specific ARARs identified. | Not applicable. No chemical-specific ARARs identified. | Not applicable. No chemical-specific ARARs identified. |
| Location-Specific ARARs | Not applicable. No action would be taken | Complies with all federal, state, and local ARARs.<br><br>Would require appropriate provisions and considerations related to stormwater drainage and planning within the flood plain. | Complies with all federal, state, and local ARARs.<br><br>Would require appropriate provisions and considerations related to stormwater drainage and planning within the flood plain. | Complies with all federal, state, and local ARARs.<br><br>Would require appropriate provisions and considerations related to stormwater drainage and planning within the flood plain. |
| Action-Specific ARARs | Not applicable. No action would be taken | Complies with all federal, state, and local ARARs.<br><br>Would require appropriate provisions and controls to ensure worker safety and proper design and implementation to meet air quality and noise control requirements. Must comply with local excavation, sewer use, and traffic control requirements. | Complies with all federal, state, and local ARARs.<br><br>Would require appropriate provisions and controls to ensure worker safety and proper design and implementation to meet air quality and noise control requirements. Must comply with local excavation, sewer use, and traffic control requirements. | Complies with all federal, state, and local ARARs.<br><br>Would require appropriate provisions and controls to ensure worker safety and proper design and implementation to meet air quality and noise control requirements. Must comply with local traffic control requirements. |
| **Satisfies Threshold Criteria?** | **No** | **Yes** | **Yes** | **Yes** |

Notes:

ARAR = applicable or relevant and appropriate requirements
COPC = chemical of potential concern
RAO = remedial action objective

Table 4-2. Detailed Analysis of Remediation Alternatives—Balancing Criteria

| Criteria | Alternative 1<br>*No Action* | Alternative 2<br>*Removal and Offsite Disposal* | Alternative 3<br>*Removal and Onsite Consolidation* | Alternative 4<br>*Cover* |
|---|---|---|---|---|
| **Long-Term Effectiveness and Permanence** | | | | |
| Magnitude of Residual Risk | Current exposure pathways and unacceptable risks would remain. | Risk would be eliminated through removal of soils containing COPCs at concentrations that exceed health-based standards. | Risk would be eliminated through removal of soils containing COPCs at concentrations that exceed health-based standards. | Risk would be eliminated through isolation of soils containing COPCs at concentrations that exceed health-based standards. |
| Adequacy and Reliability of Controls | No controls over remaining contamination. No reliability. | Because soils containing COPCs at concentrations that exceed health-based standards would be removed, no long-term controls would be required. High reliability. | Because soils containing COPCs at concentrations that exceed health-based standards would be removed, no long-term controls would be required in the Pine Yard. However, impacted soils would be consolidated under a cap in the Former Plant Area, requiring long-term controls to ensure the integrity of the cap. As a result, this alternative has a lower reliability than Alternative 2. | Long-term controls to ensure the integrity of the soil cover. As a result, this alternative has a lower reliability than Alternative 2 and a similar reliability to Alternative 3. |
| **Ranking[a]** | **4** | **1** | **2** | **3** |
| **Short-Term Effectiveness** | | | | |
| Protection of Community during Remedial Actions | No remedial action would be taken. | Temporary increase in dust and potential odor production during soil excavation, handling and transport. Dust and odor suppression measures would be used as needed. Significant increase in local truck traffic. | Temporary increase in dust and potential odor production during soil excavation, handling and transport. Dust and order suppression measures would be used as needed. Alternative 3 would not result in as a significant increase in local truck traffic as Alternative 2, because excavated impacted soils would be transported to the adjacent Former Plant Area instead of to an offsite landfill. | Temporary increase in dust during cover placement. Dust suppression measures would be used as needed. Alternative 4 would result in an significant increase in local truck traffic. Of the active alternatives, Alternative 4 will have the least potential for short-term impacts to the community relative to the other active remedial alternatives as it does not involve soil excavation. |
| Protection of Workers during Remedial Actions | No remedial action would be taken. | Low potential for worker exposure to contaminated soils, water, and volatiles. Appropriate PPE and other controls needed to ensure worker protection. Appropriate controls necessary to ensure worker safety around construction equipment, excavations, stockpiles, and other potential hazards. | Low potential for worker exposure to contaminated soils, water, and volatiles. Appropriate PPE and other controls needed to ensure worker protection. Appropriate controls necessary to ensure worker safety around construction equipment, excavations, stockpiles, and other potential hazards. | Of the active alternatives, Alternative 4 has the least potential for worker exposure to contaminated soils, water, and volatiles. Appropriate PPE and other controls needed to ensure worker protection. Appropriate controls necessary to ensure worker safety around construction equipment. |
| Potential Environmental Impacts during Remedial Actions | No remedial action would be taken. | Low relative potential for unacceptable release to the environment. Stormwater and spill prevention control measures would be used to minimize this potential. | Low relative potential for unacceptable release to the environment. Stormwater and spill prevention control measures would be used to minimize this potential. | Of the active alternatives, Alternative 4 has the least potential for unacceptable release to the environment. Stormwater and spill prevention control measures would be used to minimize this potential. |
| Time until RAOs Are Achieved | Would not meet RAOs. | Alternative 2 will be immediately effective at achieving the RAOs. | Alternative 3 will be immediately effective at achieving the RAOs. | Alternative 4 will be immediately effective at achieving the RAOs. |
| **Ranking[a]** | **1** | **4** | **3** | **2** |

Table 4-2. Detailed Analysis of Remediation Alternatives—Balancing Criteria

| Criteria | Alternative 1<br>*No Action* | Alternative 2<br>*Removal and Offsite Disposal* | Alternative 3<br>*Removal and Onsite Consolidation* | Alternative 4<br>*Cover* |
|---|---|---|---|---|
| **Reduction of Toxicity, Mobility, or Volume Through Treatment** | | | | |
| Reduction of Toxicity through Treatment | No reduction in toxicity | Although not affected through treatment, excavation and offsite disposal will effectively eliminate contaminant toxicity in OU-1 soils | Although not affected through treatment, excavation will effectively eliminate contaminant toxicity in OU-1 soils in the Pine Yard. However, these soils would remain at the KMCC Site beneath a cap and would retain their toxicity. An engineered cap would prevent exposure to the contaminated soils. | OU-1 soils beneath the cover would retain their toxicity. The soil cover would prevent exposure to the contaminated soils. |
| Reduction of Mobility through Treatment | No reduction in mobility | Although not affected through treatment, excavation and offsite disposal will effectively eliminate contaminant mobility in OU-1 soils | Although not affected through treatment, excavation will effectively eliminate contaminant mobility in OU-1 soils in the Pine Yard. However, these soils would remain at the KMCC Site beneath a cap . The low permeability cap would reduce/effectively eliminate any potential mobility of the contaminants. | The cover would reduce potential mobilization of contaminants in OU-1 soils through stormwater and wind erosion, but would not substantially influence the low potential for transport with infiltrating water to the alluvium aquifer. |
| Reduction of Volume through Treatment | No reduction in volume | Although not affected through treatment, excavation and offsite disposal will effectively eliminate the contaminant volume in OU-1 soils | Although not affected through treatment, excavation will effectively eliminate contaminant volume in OU-1 soils in the Pine Yard. However, these soils would remain at the KMCC Site beneath a cap. As a result, there would be no net reduction in the contaminant volume. | No reduction in volume |
| **Ranking**[a] | **4** | **1** | **2** | **3** |
| **Implementability** | | | | |
| Ability to Construct and Operate the Technology | Not applicable. | Relatively easy to construct and operate. | Relatively easy to construct and operate. However, this alternative requires coordination with the remedial action decision making and implementation for the Former Plant Area, which may present significant logistic and administrative challenges. | Relatively easy to construct and operate. |
| Reliability of the Technology | Not applicable. | Relies on established technologies. | Relies on established technologies. | Relies on established technologies. |
| Ease of Undertaking Additional Remedial Actions, If Necessary | No impedances to additional remedial actions beyond existing. | No impedances to additional remedial actions beyond existing. | Cap could hamper other additional actions in the Former Plant Area. | Cover could hamper other additional actions in the Pine Yard. |
| Ability to Monitor Effectiveness | No monitoring other than that necessary for the 5-year Review. | No impedances to monitoring effectiveness. | No impedances to monitoring effectiveness. | No impedances to monitoring effectiveness. |
| Ability to Obtain Approval from/Coordinate with Other Agencies | Not applicable. | No known challenges that cannot be readily overcome. | No known challenges that cannot be readily overcome. | No known challenges that cannot be readily overcome. |
| Availability of Technologies, Equipment, Services, etc. | Not applicable. | All technologies, equipment, and services are widely available. | All technologies, equipment, and services are widely available. | All technologies, equipment, and services are widely available. |
| **Ranking**[a] | **1** | **3** | **4** | **2** |
| **Cost** | | | | |
| Present Worth Cost | $180,000 | $9,892,000 | $6,465,000 | $3,141,000 |
| **State Acceptance** | | | | |
| | Not acceptable | Anticipated to be acceptable | Anticipated to be acceptable | May be acceptable. OU-1 contamination would be left in-place and may encumber future use of Pine Yard. |
| **Ranking**[a] | **4** | **1** | **2** | **3** |

Table 4-2. Detailed Analysis of Remediation Alternatives—Balancing Criteria

| Criteria | Alternative 1<br>*No Action* | Alternative 2<br>*Removal and Offsite Disposal* | Alternative 3<br>*Removal and Onsite Consolidation* | Alternative 4<br>*Cover* |
|---|---|---|---|---|
| **Community Acceptance** | | | | |
| | Not acceptable | Anticipated to be acceptable | Anticipated to be acceptable | May be acceptable. OU-1 contamination would be left in-place and may encumber future use of Pine Yard. |
| **Ranking[a]** | **4** | **1** | **2** | **3** |
| **Overall Ranking[a]** | **4 (Lowest)** | **1 (Highest)** | **3** | **2** |

Notes:
ARAR = applicable or relevant and appropriate requirement
COPC = chemical of potential concern
KMCC = Kerr-McGee Chemical Corp.
PPE = personal protective equipment
RAO = remedial action objective

[a] Relative ranking criteria: linear scale; 1 = maximum performance (highest), 4 = minimum performance (lowest)

# APPENDIX A

## SUMMARY OF PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS

# APPENDIX A
# SUMMARY OF PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS

## Previous Investigations

**1988: Interim RCRA Facility Assessment (RFA) (Kearney/Centaur 1988)**

*Purpose and Scope:* The interim RFA was conducted under contract with the U.S. Environmental Protection Agency (EPA) to assess previously unregulated releases at the site. The RFA included a preliminary review of documents, a visual site inspection, and a sampling visit.

*Relevant Findings and Recommendations:* The interim RFA report identified 41 solid waste management units (SWMUs) and 1 area of concern (AOC) at the site. Of these, 32 SWMUs were identified as having a potential for a release to one or more environmental pathways. The SWMUs included the wood treating cylinders, collection sumps and tanks, work tanks, the drip track, product tanks, sumps associated with product unloading, creosote recovery system, wastewater treating system, wastewater underground pipes, oil–water separators, cooling tower basin, waste piles, the black tie (treated lumber) storage area, and drainage ditches. The RFA report recommended additional actions, including sampling soil to assess whether releases had occurred.

**1997: RFI Report (KMCC 1997)**

*Purpose and Scope:* The RCRA facility investigation (RFI) was conducted from 1996 to 1997 to address possible releases from 15 SWMUs, which were grouped into 8 solid waste management areas (SWMAs), per the requirements of Hazardous Waste Permit No. HW-90-329-01. The RFI included sampling sediment, soil, and groundwater to assess the extent of the contaminant plume.

*Relevant Findings and Recommendations:* The RFI included a summary of interim corrective measures that had been implemented since March 1991, including source removal for impacted soils at the drip pad, work tanks, and in the black tie storage area and recovery of contaminated groundwater from three containment trenches and 11 recovery wells. The RFI results identified creosote constituents in the sediment, soil, and groundwater, and dense nonaqueous-phase liquid (DNAPL) in the groundwater. The concentrations of K001 constituents detected in the sediment and soil exceeded health standards but were reportedly immobile. The extent of the contaminant plume in groundwater had been delineated with data collected from 80 groundwater monitoring wells/piezometers and the groundwater recovery system was being operated to remove DNAPL, recover impacted groundwater, and mitigate impacted groundwater offsite. The RFI recommended continued operation of the groundwater corrective action system with enhancements. The RFI Report stated that two source areas, the former process area and the loading/unloading areas near the black tie storage area, had been identified, along with two contaminant plumes.

**1998: RFI Phase II Report (KMCC 1988)**

*Purpose and Scope:* The RFI Phase II included drip pad sump integrity testing and additional sediment, soil, and groundwater sampling.

*Relevant Findings and Recommendations:* The drip pad sump integrity testing did not identify structural problems and a 72-hour hydrostatic head test identified a leakage rate of zero. Results of the drainage ditch sediment sampling program indicated decreasing concentrations of PAHs with distance from the site, except where other contributing sources were identified. Source control measures on the site were believed to be effective for mitigating further offsite migration, and the report recommended natural attenuation as the remedy for offsite impacts to ditches. Soil sampling was conducted along the southwest portion of the site boundary and a “visually clean” line was delineated along that boundary. Additional groundwater monitoring wells were installed in the northeastern and southeastern portions of the Site, and laboratory analyses identified creosote constituent concentrations below the laboratory reporting limit.

**2002: Supplemental Phase II RCRA Facility Investigation (ERM 2002)**

*Purpose and Scope:* The supplemental Phase II RFI was conducted in 2001 and 2002 to further assess impacts to sediment and surface water in the offsite ditches

*Relevant Findings and Recommendations:* The assessment included 13 sampling locations in a residential setting and 20 within an industrial/commercial setting in the site vicinity to the north, west, and east. Polycyclic aromatic hydrocarbons (PAHs) were detected in sediments from offsite ditches at concentrations that exceeded the USEPA Region 9 preliminary remediation goals (PRGs); however, the locations impacted reportedly did not indicate a discernible distribution pattern. The report attributed the PAHs to multiple industrial and natural sources.

**2006: Soil Assessment: Cemetery, Columbus Facility, Columbus, Mississippi (ERM 2006)**

*Purpose and Scope:* The assessment was conducted on leased property located south of the site and west of an existing cemetery to identify potential hydrocarbon impacts to shallow soil from historical wood treatment operations at the site.

*Relevant Findings and Recommendations:* A total of 102 soil borings were advanced and 78 soil samples were tested using an Ensys™ PAH Soil Test Kit. A total of 20 samples were submitted for laboratory analyses. Concentrations of PAH compounds exceeded Missouri Department of Environmental Quality (MDEQ) and EPA standards, primarily in the northern two-thirds of the cemetery. A total of 17 soil samples contained laboratory-reported PAH constituents at concentrations above risk-based standards.

**2008: Health Consultation, Exposure Investigation Report, Drinking Water Sampling from Homes Near the Kerr McGee Chemical Corporation, Columbus, MS / Agency for Toxic Substances and Disease Registry (ATSDR 2008a)**

*Purpose and Scope:* The purpose of the Agency for Toxic Substances and Disease Registry (ATSDR) exposure investigation was to determine whether nearby residents were being exposed to harmful levels of chemicals associated with the site through their drinking water. Tap water samples were collected from 16 locations near the site and from water treatment plants on Waterworks Road and a second plant 3 miles south of the site. The samples were analyzed for PAHs, phenols, total petroleum hydrocarbons, turbidity, pH, iron, manganese, sulfide, and residual chlorine. Two samples were also tested for dioxins/furans.

*Relevant Findings and Recommendations:* The report concluded, "there is no indication that chemicals associated with the former wood-treating plant are infiltrating the city's drinking water system."

**2008: Health Consultation, Exposure Investigation for Fish Dioxin Testing, Former Kerr McGee Chemical Corporation, Columbus, MS (ATSDR 2008b)**

*Purpose and Scope:* The purpose of the exposure investigation was to determine whether fish in Luxapalila Creek contained concentrations of dioxins and furans that pose a public health hazard to people who eat the fish. Composite samples of fish were collected from one location approximately 5 miles northeast and upstream of the Site and one location along a section of stream that may have received surface runoff from the site.

*Relevant Findings and Recommendations:* Measured concentrations of dioxin toxicity equivalents (TEQ) in the samples ranged from 0.005 to 0.150 parts per trillion (wet weight). The report concluded, "…low concentrations of dioxins were detected in fish collected from Luxapalila Creek. Consumption of these fish would not pose a public health hazard. The concentrations of dioxins in fish from Luxapalila Creek near the site were similar to those detected in fish from an upstream control area. These results support the conclusion that fish in Luxapalila Creek have not been impacted by dioxin contamination from the Site."

**2009: Public Health Assessment for Air Exposures to Wood Treatment Chemicals, Kerr-McGee Chemical Corporation, Columbus, MS (ATSDR 2009)**

*Purpose and Scope:* The document focused on exposure to airborne contaminants, pentachlorophenol (PCP), creosote constituents, and dioxins. The scope of work included document review, blood and urine sampling, and fence-line air sampling.

*Relevant Findings and Recommendations:* Aside from discussions of exposure during historical operations, the report concluded that small amounts of naphthalene and associated chemicals are released to the air when it rains because rainwater fills the pore spaces in the soil and pushes out the vapors. The report stated that the levels released are lower than most instruments can detect and do not pose a health risk.

**2011: Memorandum, Data Evaluation, Off-Site Soil Sampling, Tronox (Kerr-McGee) Site, Columbus, Lowndes County, MS (USEPA 2011)**

*Purpose and Scope:* The purpose of the memorandum was to review and summarize data from soil samples collected in 2010 by the RCRA program and in 2010 and 2011 by the Superfund program. Soil samples were collected from Hunt School, Maranatha Faith Center, the adjacent cemetery, and nearby residential properties during three separate events. The data was compared to regional screening levels (RSLs) and removal action levels (RALs).

*Relevant Findings and Recommendations:* The RCRA 2010 sampling identified exceedances of the RSLs for several PAHs with the RAL exceeded for benzo[*a*]pyrene at one location, which was a low-lying residence adjacent to a ditch that collects surface water from the site. Dioxins were detected above the provisional screening level for dioxin TEQ at three locations, but did not exceed the Office of Solid Waste and Emergency Response (OSWER) action level. Sediments from ditches were found to exceed the RALs for one or more PAHs in five samples. Based on the RCRA 2010 results, the project was turned over to the Superfund program for additional investigation.

The Superfund 2010 sampling included 49 soil samples from 39 properties. PAHs were detected above the RSLs in several samples but only one sample (collected at the Hunt School property) contained PAH constituents (i.e., benzo[*a*]pyrene) above the RAL. There were seven samples that exceeded the provisional screening value for dioxin TEQ in residential soil; however, no dioxin TEQ concentrations exceeded the OSWER residential action level.

The Superfund 2011 sampling included resampling for dioxins at the same locations as the Superfund 2010 sampling and additional sampling of a waste pile at the Maranatha Faith Center property. Of these, five samples had a dioxin TEQ that exceeded the provisional screening value for residential soil, but none exceeded the OSWER action level. A number of semivolatile organic compounds (SVOCs) were detected above the RAL in the waste pile sample.

The memorandum stated that all concentrations that exceeded the RAL have been addressed through removal actions at a residence near sample location TN09 (i.e. 1009 Moss Street), the school property, and the waste pile at the Maranatha Faith Center.

**2012: 14th Avenue Ditch Investigation, Former Kerr McGee Facility, Columbus, MS (URS 2012)**

*Purpose and Scope:* The purpose of the investigation was to evaluate the potential surface water/groundwater interactions in the 14th Avenue ditch and evaluate soil impacts within the 75-ft-wide area of interest south of the ditch and to determine management options for excavated soil. Twelve soil borings were advanced and four piezometers were installed. Soil samples were analyzed for PAHs, PCP, xylene, and dioxins/furans.

PAHs were detected in the composite soil samples collected from the top 5 ft from each boring at concentrations above the residential RSLs but below the RALs. Dioxin TEQ was detected but at concentrations below the residential RSL. A monthly water level management program was initiated for a 6-month period to assess surface water–groundwater interaction. The report did not include results.

**2013: Final Interim RI Report, 14th Avenue Ditch Area, Columbus, Lowndes County, Mississippi (Tetra Tech 2013)**

*Purpose and Scope:* The purpose was to delineate the nature and extent of environmental impacts from historical site activities in the area of the 14th Avenue ditch, provide a volume estimate of contaminated soil, provide an estimate for management of excavated soil, and obtain data for a preliminary baseline risk assessment and a site-wide feasibility study. The assessment included sampling ditch sediment, soil along the ditch and on residential properties to the north, and installing and sampling monitoring wells. Samples were analyzed for volatile organic compounds (VOCs), SVOCs, pesticides, polychlorinated biphenyls (PCBs), metals, hexavalent chromium, and dioxins/furans.

*Relevant Findings and Recommendations:* Tetra Tech reported the following general conclusions based on the results of the interim remedial investigation:

- Sediment and subsurface soil to be excavated should be managed as contaminated material.
- Subsurface soil samples collected on the eastern half of the site adjacent to the 14th Avenue Ditch do not require management as contaminated material and may be reused during construction of the new 14th Avenue Ditch.

- A groundwater sample collected from a well (RP-04) installed in the vicinity of two former gas stations, where visible contamination had been observed, contained contaminants above screening levels.

Groundwater on the north side of the 14th Avenue Ditch flows to the east and southeast toward 14th Avenue North and the site.

**2014: Public Health Assessment for Kerr-McGee Chemical Corporation (a/k/a Tronox, Inc.), Columbus, Lowndes County, Mississippi (ATSDR 2014)**

*Purpose and Scope:* The purpose of the document was to describe the ATSDR health assessment activities at the site and to provide the agency's opinion about the public health significance of exposure to chemicals at the site. The document was prepared in response to a petition received from citizens of Columbus, and considered previous ASTDR environmental investigations, environmental sampling data from the RFI, RFI Phase II, Supplemental RFI Phase II, prior removal actions, 14th Avenue ditch assessments, residential soil and ditch sampling, offsite surface water sampling, an exposure pathways analysis, and evaluation of public health implications.

*Relevant Findings and Recommendations:* The public health assessment (PHA) included the following conclusions and recommendations regarding remaining health hazards:

1. Contact with dioxin in surface soil in some residential yards could harm people's health. Surface soil samples collected from residential yards in 2010 and 2011 revealed the presence of dioxins at levels that might cause children to experience non-cancer health effects. The PHA recommended that proper measures be taken to reduce people's exposure to dioxin in soil in residential yards or public places where the levels represent a hazard.
2. Frequent contact with contaminated sediment in neighborhood ditches could harm people's health. This is a past public health hazard. Current public health implications could not be determined because the conclusion was based on sampling and removal actions prior to the erosion and flood events of 2010, which may have altered contaminant conditions in the ditches.
3. There is a lack of information regarding current contaminant levels in offsite ditches. Therefore, the PHA was unable to evaluate the current public health implications of this pathway and additional sampling was recommended.
4. Occasional trespassing on the KMCC property (onsite) is not expected to harm people's health.

**2014: Laboratory reports, figures, and tables compiled for Limited Remedial Investigation (LRI) / Bhate Environmental Associates, Inc. (Tables and figures generated for the LRI were attached to the 2015 RI/FS Work Plan Addendum.)**

*Purpose and Scope:* The Multistate Trust's contractor, Bhate conducted the LRI to determine whether site-related constituents were present in surface soils and stormwater ditches at concentrations that may present an unacceptable exposure risk to the community through direct contact. Field sampling consisted of offsite soil, sediment, and residential yard sampling north, south, east, and west of the Site. There were 14 5-point composite soil samples collected from up to 2.5 miles from the site to determine background concentrations of VOCs, SVOCs, dioxin/furans, PCBs, and metals in the vicinity of the site. Another 18 composite soil samples were collected from nearby residential yards located north, west, southwest, and southeast of the Site and the Maranatha Faith Center property and analyzed for the same constituents. A total of 55 sediment and soil samples were collected from the 14$^{th}$ Avenue North drainage ditch, main drainage ditch, and ditches 1 and 4.

*Relevant Findings and Recommendations:* The results of this event showed the following:

- In background surface soil sampling benzo[*a*]pyrene was detected above the residential RSL of 0.016 mg/kg in 4 of 14 samples with concentrations ranging from 0.0586 to 0.120 mg/kg. Dioxin TEQ was detected above the residential RSL of 4.8 ng/kg in one sample at a concentration of 7.27 ng/kg. Dieldrin was detected above the residential RSL of 0.034 mg/kg in one sample at a concentration of 0.265 mg/kg.
- Background ditch sediment/soil sampling showed PAHs were detected above the residential RSLs in one of five samples. That sample was collected along the northern side of 14$^{th}$ Avenue North. Arsenic was detected at concentrations that exceeded the residential RSL of 0.680 mg/kg in four of five samples (concentrations ranged from 2.03 to 14.1 mg/kg).
- Residential yard surface soil sample results showed PAHs, dioxin TEQ, and/or PCP were detected at concentrations that exceeded residential RSLs in seven residential yards and from the Maranatha Faith Center, and dieldrin was detected above the residential RSL in two residential yards. The constituents detected did not exceed the removal management levels (RMLs).
- Ditch sampling results showed that, of the 55 samples collected from the ditches (including the 14$^{th}$ Avenue North ditch), 46 contained one or more analytes at concentrations above the residential RSL and 16 of the same samples contained one or more analytes above the RML.

## Removal Actions

**2005: Ditch Sediment Removal Documented in the Interim Measures Report (ERM 2005)**

Interim measures were completed to remove PAH-impacted sediments in the ditch system along the eastern site boundary. Impacted soil in 1,850 linear feet of ditch was removed along the eastern side of the Former Plant Area and within two railroad rights-of-way. The interim measures addressed 1,850 linear feet of ditches in four areas (Areas 1–4). Area 1 was located on the southern side of 14th Avenue North near 22nd Street. Area 2 extended from the northeastern corner of the KMCC property and continued southerly for a distance of 255 ft to a point where the ditch flowed beneath railroad tracks. The portion beneath the railroad tracks was not excavated. The ditch excavation continued southerly along the eastern side of the railroad tracks and within the right-of-way for a distance of 750 ft to an intersection with another ditch (Area 4). The Area 4 ditch was also excavated as part of the interim measures.

**2006/2007: Ditch Sediment Removal Documented in the Ditch Investigation & Remediation Report, Propst Part & 7th Avenue, 2006-2007 (Tronox 2010)**

In 2006 and 2007, creosote-impacted soil was discovered during a City of Columbus drainage improvement project that began at Propst Park, approximately 2,200 ft southeast of the site at the eastern end of 7th Avenue North (Tronox 2010). The City requested that Tronox, LLC (Tronox), assess the nature and extent of the affected soils and implement remedial activities, if necessary. Based on the assessments conducted by Tronox, remedial activities were conducted in Propst Park between 7th Avenue and 5th Avenue, as well as approximately 130 ft of ditch at the eastern end of 7th Avenue. The section of the ditch downstream from 5th Avenue had reportedly been addressed in an earlier drainage project and the banks were lined with gabions and rip-rap. The report stated that creosote impacts occurred in pockets of various sizes and shapes rather than as continuous deposits over the length of the remediation area. Impacted soil was excavated and disposed offsite. A total of 24 confirmation samples were collected and the ditch was backfilled. For 1 of the 24 confirmation samples benzo[*a*]pyrene was found at a concentration over the EPA Region 9 PRG of October 2004, with a residential target risk of $1 \times 10^{-4}$.

**2010/2011: Hunt School Removal Action Documented in the Final Removal Action Letter Report, Kerr McGee Chemical (Columbus) Removal, Columbus, Lowndes County, Mississippi (Tetra Tech 2011).**

Removal evaluations and actions were conducted by Tetra Tech from October 2010 to May 2011. Removal actions were conducted at Hunt Intermediate School, at a residential property at 1009 Moss Street, and at Maranatha Faith Center. The removal action at Hunt Intermediate School consisted of excavating a 50- by 50-ft area in the former football field to a depth of 1 ft below ground surface and removing approximately 99.41 tons of soil, The removal action at 1009 Moss Street was conducted in the northeastern portion of the property and extended to a depth of 1 ft over the majority of the excavation area, removing approximately 148.6 tons of soil. The action at Maranatha Faith Center involved removal of a soil pile containing approximately 30.93 tons. The soil from each location was transported to the Golden Triangle Subtitle D Landfill and disposed of as non-hazardous waste.

**2014/2015: 14th Avenue Ditch Improvement Project Documented in 14th Avenue Ditch Improvement Project, Former Kerr-McGee Wood Treating Facility, Columbus, Mississippi (Tetra Tech 2015 [October 13])**

The Multistate Trust's contractor (Tetra Tech) performed the excavation necessary to construct the new 14th Avenue North ditch and provide a clean work area for the City of Columbus to construct a new concrete-lined drainage way. During excavation of the new ditch, which runs parallel to 14th Avenue North through the northerly portion of the site, there was little visual evidence of soil contamination. Further, analytical results of samples of the excavated materials (which are currently stockpiled on the site) showed that no site-related constituents were present at concentrations exceeding their respective residential RSLs. As part of the 14th Avenue North ditch project, Tetra Tech also removed contaminated sediment from the bottom of the old ditch and placed the spoils in a corner of the onsite stockpile, segregated from the soils excavated during construction of the new ditch. The environmental actions and the construction project were completed in 2015.

**2016: Residential Yard Removal Action**

Soil was removed from the backyard of the residential property located at 2614 17th Avenue North where benzo[*a*]pyrene concentrations were found to exceed residential RMLs. The soil removal encompassed an area of approximately 61 ft wide, 56 ft long, and 1 ft deep. A total of 126 cubic yards was removed and taken to the Golden Triangle Regional Landfill for disposal. The excavation was backfilled with clean soil and completed to grade with 4 in. of topsoil and sod.

**2016: 7th Avenue North Storm Drainage Ditch Removal Action**

The first removal action to address creosote-contaminated ditch sediments and soils was implemented along the north side of 7th Avenue North, between the Maranatha Faith Center and North 28th Street. This removal action involved excavating approximately 7,000 cubic yards of sediment and soil in the main ditch along 7th Avenue. A total of 2,640 cubic yards was transported to the Golden Triangle Regional Landfill for disposal. After contaminated sediments were removed, a box culvert was installed to return the ditch to service.

# ATTACHMENT B

## DETAILED COST ESTIMATE FOR REMEDIAL ALTERNATIVES

Appendix B. Detailed Cost Estimate for Remedial Alternatives

| | | | | Alternative 1 - No Action | | Alternative 2 - Removal and Offsite Disposal | | Alternative 3 - Removal and Onsite Consolidation | | Alternative 4 - Cover | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Item | Description | Unit[a] | Unit Cost ($)[b] | Quantity[c] | Total Cost ($)[d] | Quantity[c] | Total Cost ($)[d] | Quantity[c] | Total Cost ($)[d] | Quantity[c] | Total Cost ($)[d] | Key Assumptions |
| **DIRECT CAPITAL COSTS** | | | | | | | | | | | | |
| 1 | Mobilization & Demobilization | % | 1.50% | 0 | $ - | 1 | $ 89,000 | 1 | $ 57,000 | 1 | $ 27,000 | 1 |
| 2 | Contractor Plans and Submittals | LS | $ 20,000 | 0 | $ - | 1 | $ 20,000 | 1 | $ 20,000 | 1 | $ 20,000 | 2 |
| 3 | Construction Quality Control | WK | $ 9,000 | 0 | $ - | 24 | $ 216,000 | 24 | $ 216,000 | 24 | $ 216,000 | 3 |
| 4 | Temporary Facilities | MO | $ 20,242 | 0 | $ - | 6 | $ 121,000 | 6 | $ 121,000 | 6 | $ 121,000 | 3 |
| 5 | Site Access and Traffic Control | LS | $ 55,000 | 0 | $ - | 1 | $ 55,000 | 1 | $ 55,000 | 1 | $ 55,000 | 4 |
| 6 | Surveying and Field Engineering | LS | varies | 0 | $ - | 1 | $ 93,700 | 1 | $ 93,700 | 1 | $ 50,000 | 5 |
| 7 | Construction Pollution Prevention Control | LS | $ 129,040 | 0 | $ - | 1 | $ 129,000 | 1 | $ 129,000 | 1 | $ 129,000 | 6 |
| 8 | Zone 2 Soil Removal (0-2 ft bgs) | | | | | | | | | | | |
| | Excavation | CY | $ 15.0 | 0 | $ - | 41,616 | $ 624,000 | 41,616 | $ 624,000 | 0 | $ - | 7 |
| | Backfill and Grading | CY | $ 15.0 | 0 | $ - | 59,511 | $ 893,000 | 59,511 | $ 893,000 | 0 | $ - | 8 |
| | Transport and Disposal | TN | $ 38.25 | 0 | $ - | 66,586 | $ 2,547,000 | 0 | $ - | 0 | $ - | 9 |
| | **ZONE 2 REMOVAL SUBTOTAL** | | | | | | **$ 4,064,000** | | **$ 1,517,000** | | **$ -** | |
| 9 | Zone 3 Soil Removal (2-8 ft bgs) | | | | | | | | | | | |
| | Excavation | CY | $ 15.00 | 0 | $ - | 11,943 | $ 179,000 | 11,943 | $ 179,000 | 0 | $ - | 7,10 |
| | Backfill and Grading | CY | $ 15.00 | 0 | $ - | 17,079 | $ 256,000 | 17,079 | $ 256,000 | 0 | $ - | 8,10 |
| | Transport and Disposal | TN | $ 38.25 | 0 | $ - | 19,109 | $ 731,000 | 0 | $ - | 0 | $ - | 9,10 |
| | **ZONE 3 REMOVAL SUBTOTAL** | | | | | | **$ 1,166,000** | | **$ 435,000** | | **$ -** | |
| 10 | Onsite Soil Consolidation and Impermeable Cap | LS | $ 1,154,173 | 0 | $ - | 0 | $ - | 1 | $ 1,154,000 | 0 | $ - | 11 |
| 11 | Clean Soil Cover | SF | $ 2.01 | 0 | $ - | 0 | $ - | 0 | $ - | 561,816 | $ 1,129,000 | 12 |
| 12 | Site Restoration | LS | $ 64,472 | 0 | $ - | 1 | $ 64,000 | 1 | $ 64,000 | 1 | $ 64,000 | 13 |
| | **CONSTRUCTION SUBTOTAL** | | | | **$ -** | | **$ 6,017,700** | | **$ 3,861,700** | | **$ 1,811,000** | |
| | **CONTINGENCY (30%)** | | | | **$ -** | | **$ 1,805,000** | | **$ 1,159,000** | | **$ 543,000** | |
| | **Tax (7%)** | | | | **$ -** | | **$ 548,000** | | **$ 351,000** | | **$ 165,000** | |
| | **TOTAL DIRECT CAPITAL COSTS** | | | | **$ -** | | **$ 8,371,000** | | **$ 5,372,000** | | **$ 2,519,000** | |
| **INDIRECT COSTS** | | | | | | | | | | | | |
| 1 | Project Management | % | varies | 0 | $ - | 5% | $ 419,000 | 5% | $ 269,000 | 6% | $ 151,000 | 14 |
| 2 | Construction Management | % | 7% | 0 | $ - | 1 | $ 586,000 | 1 | $ 376,000 | 1 | $ 176,000 | 15 |
| 3 | Contractor Payment and Performance Bonds | % | 4% | 0 | $ - | 1 | $ 376,000 | 1 | $ 241,000 | 1 | $ 113,000 | |
| 4 | Institutional Controls | LS | varies | 1 | $ 75,000 | 1 | $ 50,000 | 1 | $ 75,000 | 1 | $ 50,000 | 16,17,18 |
| | **TOTAL INDIRECT COSTS** | | | | **$ 75,000** | | **$ 1,431,000** | | **$ 961,000** | | **$ 490,000** | |
| **PERIODIC COSTS** | | | | | | | | | | | | |
| 1 | Update Institutional Controls Plan | YR | 2,500 | 6 | $ 15,000 | 0 | $ - | 6 | $ 15,000 | 6 | $ 15,000 | 19 |
| 2 | O&M | YR | 900 | 0 | $ - | 0 | $ - | 30 | $ 27,000 | 30 | $ 27,000 | 19 |
| 3 | Five Year Review | YR | 15,000 | 6 | $ 90,000 | 6 | $ 90,000 | 6 | $ 90,000 | 6 | $ 90,000 | 19 |
| | **TOTAL PERIODIC COSTS** | | | | **$ 105,000** | | **$ 90,000** | | **$ 132,000** | | **$ 132,000** | |
| **TOTAL NET PRESENT VALUE (-30% to +50%)** | | | | | **$ 180,000** | | **$ 9,892,000** | | **$ 6,465,000** | | **$ 3,141,000** | 19 |

Appendix B. Detailed Cost Estimate for Remedial Alternatives

Notes:

TN = tons

LS = lump sum

[a] All materials unit rates include costs for purchase, loading, and delivery of materials to the site, along with quality control sampling, overhead, and profit.

[b] Unit costs include contractor overhead and profit.

[c] All quantities are estimates, which may be refined.

[d] Total costs are rounded to the nearest $1,000. Consistent with USEPA guidance, costs estimated within -30% to +50% accuracy.

Key Assumptions:

1 Assume 1.5% of other total direct construction costs for personnel and equipment mobilization/demobilization.
2 Assume Contractor's pre-construction submittals consist of 13 separate plans at roughly $1,500 each to prepare, including client and EPA approval.
3 Assume 6 month (24 week) construction duration for each alternative.
4 Includes provisions for flagger, traffic cones, and signage.
5 Includes provisions for pre-construction conditions survey, excavation progress surveys (if applicable), final site conditions survey, and record documentation.
6 Includes provisions for site stormwater best management practices, odor suppresants (if needed), spill control measures, and equipment decontamination areas.
7 Includes excavation, loading and stockpiling (if needed) of soil and debris.
8 Includes imported backfill materials, placement, compaction and final grading.
9 Assumes all excavated soil is transported to Golden Triangle Regional Landfill for disposal as non-hazardous waste. Unit costs for transport and disposal based on estimate provided by J-5/Earthcon.
10 Quantity assumes additional soil is generated to maintain safe/stable excavation sideslopes (30 percent of neatline volume).
11 Assumes excavated soil is consolidated onto former plant area and capped with impermeable cap.
12 Assumes placement of geotextile demarcation layer on existing ground surface followed by 2 ft of clean fill and topsoil.
13 Includes provisions for hydroseeding final site grades. Assumed to be equivalent for each alternative.
14 Percentage consistent with EPA FS guidance. Includes planning, reporting, community relations, contract administration, and legal services outside of institutional controls.
15 Includes review of submittals, design modifications, construction observation or oversight, documentation of quality control/quality assurance.
16 Percentage consistent with EPA FS guidance, with additional provisions for analytical laboratory services.
17 Institutional controls anticipated to consist of establishment of a deed restriction, soil management plan, signage (if appropriate).
18 Alternative 1 assumed to require additional site security measures.
19 Alternative 3 assumed to require more rigorous cap monitoring and maintenance plan.
20 For this Focused Feasibility Study a zero percent discount factor has been assumed for simplicity.

# APPENDIX C

## RISK CHARACTERIZATION SUMMARIES FOR THE HUMAN HEALTH RISK ASSESSMENT

Table C-1. Risk Characterization Summary - Cancer

| Scenario Timeframe: Future<br>Receptor Population: Resident<br>Receptor Age: Child and Adult | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Carcinogenic Risk | | | |
| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface Soil | Pine Yard | TEQdf | 1.3E-03 | NA | 1.1E-04 | 1.4E-03 |
| | | | Benzo[a]pyrene | 3.2E-04 | NA | 1.0E-04 | 4.2E-04 |
| | | | Benzo[a]anthracene | 7.6E-05 | NA | 2.6E-05 | 1.0E-04 |
| | | | Benzo[b]fluoranthene | 4.9E-05 | NA | 1.6E-05 | 6.5E-05 |
| | | | Benzo[k]fluoranthene | 2.1E-06 | NA | 6.9E-07 | 2.8E-06 |
| | | | Dibenzo[a,h]anthracene | 4.9E-05 | NA | 1.6E-05 | 6.5E-05 |
| | | | Indeno[1,2,3-cd]pyrene | 1.3E-05 | NA | 4.1E-06 | 1.7E-05 |
| | | | Dibenzofuran | -- | NA | -- | -- |
| | | | Chrysene | 1.1E-06 | NA | 3.6E-07 | 1.5E-06 |
| | | | Fluoranthene | -- | NA | -- | -- |
| | | | Naphthalene | 8.4E-06 | NA | 3.1E-06 | 1.2E-05 |
| | | | Carbazole | 4.0E-06 | NA | NA | 4.0E-06 |
| | | | Pyrene | -- | NA | -- | NA |
| | | | 2-Methylnaphthalene | -- | NA | -- | NA |
| | | | 1,1'-Biphenyl | 8.7E-08 | NA | NA | 8.7E-08 |
| | | | Pentachlorophenol | 1.9E-05 | NA | 1.4E-05 | 3.3E-05 |
| | | | Arsenic | 6.7E-05 | NA | 9.4E-06 | 7.6E-05 |
| | Surface soil particulates | Pine Yard | TEQdf | NA | 6.5E-08 | NA | 6.5E-08 |
| | | | Benzo[a]pyrene | NA | 1.6E-08 | NA | 1.6E-08 |
| | | | Benzo[a]anthracene | NA | 3.7E-09 | NA | 3.7E-09 |
| | | | Benzo[b]fluoranthene | NA | 2.4E-09 | NA | 2.4E-09 |
| | | | Benzo[k]fluoranthene | NA | 1.0E-10 | NA | 1.0E-10 |
| | | | Dibenzo[a,h]anthracene | NA | 2.4E-09 | NA | 2.4E-09 |
| | | | Indeno[1,2,3-cd]pyrene | NA | 6.3E-10 | NA | 6.3E-10 |
| | | | Dibenzofuran | NA | -- | NA | -- |
| | | | Chrysene | NA | 5.5E-11 | NA | 5.5E-11 |
| | | | Fluoranthene | NA | -- | NA | -- |
| | | | Naphthalene | NA | 4.2E-10 | NA | 4.2E-10 |
| | | | Carbazole | NA | 1.6E-07 | NA | 1.6E-07 |
| | | | Pyrene | NA | -- | NA | -- |
| | | | 2-Methylnaphthalene | NA | -- | NA | -- |
| | | | 1,1'-Biphenyl | NA | -- | NA | -- |
| | | | Pentachlorophenol | NA | 4.3E-11 | NA | 4.3E-11 |
| | | | Arsenic | NA | 5.6E-08 | NA | 5.6E-08 |

Table C-1. Risk Characterization Summary - Cancer

| Scenario Timeframe: Future<br>Receptor Population: Resident<br>Receptor Age: Child and Adult | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Carcinogenic Risk | | | |
| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface soil volatiles | Pine Yard | TEQdf | NA | 4.5E-05 | NA | 4.5E-05 |
| | | | Benzo[a]pyrene | NA | NA | NA | NA |
| | | | Benzo[a]anthracene | NA | 1.1E-06 | NA | 1.1E-06 |
| | | | Benzo[b]fluoranthene | NA | NA | NA | NA |
| | | | Benzo[k]fluoranthene | NA | NA | NA | NA |
| | | | Dibenzo[a,h]anthracen | NA | NA | NA | NA |
| | | | Indeno[1,2,3-cd]pyrene | NA | NA | NA | NA |
| | | | Dibenzofuran | NA | -- | NA | -- |
| | | | Chrysene | NA | NA | NA | NA |
| | | | Fluoranthene | NA | NA | NA | NA |
| | | | Naphthalene | NA | 1.2E-05 | NA | 1.2E-05 |
| | | | Carbazole | NA | NA | NA | NA |
| | | | Pyrene | NA | -- | NA | -- |
| | | | 2-Methylnaphthalene | NA | -- | NA | -- |
| | | | 1,1'-Biphenyl | NA | -- | NA | -- |
| | | | Pentachlorophenol | NA | NA | NA | NA |
| | | | Arsenic | NA | NA | NA | NA |
| | | | | | | Soil risk total = | 2E-03 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quantitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-2. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface Soil | Pine Yard | TEQdf | 120 | NA | 8.8 | 130 |
| | | | Benzo[a]pyrene | 2.2 | NA | 0.68 | 2.9 |
| | | | Benzo[a]anthracene | -- | NA | -- | -- |
| | | | Benzo[b]fluoranthene | -- | NA | -- | -- |
| | | | Benzo[k]fluoranthene | -- | NA | -- | -- |
| | | | Dibenzo[a,h]anthracene | -- | NA | -- | -- |
| | | | Indeno[1,2,3-cd]pyrene | -- | NA | -- | -- |
| | | | Dibenzofuran | 0.85 | NA | 0.26 | 1.1 |
| | | | Chrysene | -- | NA | -- | -- |
| | | | Fluoranthene | 0.42 | NA | 0.13 | 0.55 |
| | | | Naphthalene | 0.031 | NA | 0.0096 | 0.041 |
| | | | Carbazole | -- | NA | NA | -- |
| | | | Pyrene | 0.24 | NA | 0.073 | 0.31 |
| | | | 2-Methylnaphthalene | 0.15 | NA | 0.046 | 0.20 |
| | | | 1,1'-Biphenyl | 0.00019 | NA | NA | 0.00019 |
| | | | Pentachlorophenol | 0.086 | NA | 0.051 | 0.14 |
| | | | Arsenic | 1.3 | NA | 0.16 | 1.5 |
| | Surface soil particulates | Pine Yard | TEQdf | NA | 0.00011 | NA | 0.00011 |
| | | | Benzo[a]pyrene | NA | 0.018 | NA | 0.018 |
| | | | Benzo[a]anthracene | NA | -- | NA | -- |
| | | | Benzo[b]fluoranthene | NA | -- | NA | -- |
| | | | Benzo[k]fluoranthene | NA | -- | NA | -- |
| | | | Dibenzo[a,h]anthracene | NA | -- | NA | -- |
| | | | Indeno[1,2,3-cd]pyrene | NA | -- | NA | -- |
| | | | Dibenzofuran | NA | -- | NA | -- |
| | | | Chrysene | NA | -- | NA | -- |
| | | | Fluoranthene | NA | -- | NA | -- |
| | | | Naphthalene | NA | 0.000011 | NA | 0.000011 |
| | | | Carbazole | NA | -- | NA | -- |
| | | | Pyrene | NA | -- | NA | -- |
| | | | 2-Methylnaphthalene | NA | -- | NA | -- |
| | | | 1,1'-Biphenyl | NA | 0.000013 | NA | 0.000013 |
| | | | Pentachlorophenol | NA | -- | NA | -- |
| | | | Arsenic | NA | 0.0023 | NA | 0.0023 |

Table C-2. Risk Characterization Summary - Noncancer

| Scenario Timeframe: Future<br>Receptor Population: Resident<br>Receptor Age: Child | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Noncancer Risk | | | |
| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface soil volatiles | Pine Yard | TEQdf | NA | 0.080 | NA | 0.080 |
| | | | Benzo[a]pyrene | NA | NA | NA | NA |
| | | | Benzo[a]anthracene | NA | -- | NA | -- |
| | | | Benzo[b]fluoranthene | NA | NA | NA | NA |
| | | | Benzo[k]fluoranthene | NA | NA | NA | NA |
| | | | Dibenzo[a,h]anthracene | NA | NA | NA | NA |
| | | | Indeno[1,2,3-cd]pyrene | NA | NA | NA | NA |
| | | | Dibenzofuran | NA | -- | NA | -- |
| | | | Chrysene | NA | NA | NA | NA |
| | | | Fluoranthene | NA | NA | NA | NA |
| | | | Naphthalene | NA | 0.32 | NA | 0.32 |
| | | | Carbazole | NA | NA | NA | NA |
| | | | Pyrene | NA | -- | NA | -- |
| | | | 2-Methylnaphthalene | NA | -- | NA | -- |
| | | | 1,1'-Biphenyl | NA | 0.15 | NA | 0.15 |
| | | | Pentachlorophenol | NA | NA | NA | NA |
| | | | Arsenic | NA | NA | NA | NA |
| | | | | | | Soil HI total = | 100 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quantitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-3. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk Ingestion | Inhalation | Dermal | Exposure Routes Total |
|---|---|---|---|---|---|---|---|
| Soil | Surface Soil | Pine Yard | TEQdf | 12 | NA | 1.5 | 13 |
| | | | Benzo[a]pyrene | 0.21 | NA | 0.11 | 0.32 |
| | | | Benzo[a]anthracene | -- | NA | -- | -- |
| | | | Benzo[b]fluoranthene | -- | NA | -- | -- |
| | | | Benzo[k]fluoranthene | -- | NA | -- | -- |
| | | | Dibenzo[a,h]anthracene | -- | NA | -- | -- |
| | | | Indeno[1,2,3-cd]pyrene | -- | NA | -- | -- |
| | | | Dibenzofuran | 0.080 | NA | 0.044 | 0.12 |
| | | | Chrysene | -- | NA | -- | -- |
| | | | Fluoranthene | 0.039 | NA | 0.022 | 0.061 |
| | | | Naphthalene | 0.0029 | NA | 0.0016 | 0.0045 |
| | | | Carbazole | -- | NA | NA | -- |
| | | | Pyrene | 0.022 | NA | 0.012 | 0.034 |
| | | | 2-Methylnaphthalene | 0.014 | NA | 0.008 | 0.022 |
| | | | 1,1'-Biphenyl | -- | NA | -- | -- |
| | | | Pentachlorophenol | 0.008 | NA | 0.009 | 0.017 |
| | | | Arsenic | 0.12 | NA | 0.026 | 0.15 |
| | Surface soil particulates | Pine Yard | TEQdf | NA | 0.00011 | NA | 0.00011 |
| | | | Benzo[a]pyrene | NA | 0.018 | NA | 0.018 |
| | | | Benzo[a]anthracene | NA | -- | NA | -- |
| | | | Benzo[b]fluoranthene | NA | -- | NA | -- |
| | | | Benzo[k]fluoranthene | NA | -- | NA | -- |
| | | | Dibenzo[a,h]anthracene | NA | -- | NA | -- |
| | | | Indeno[1,2,3-cd]pyrene | NA | -- | NA | -- |
| | | | Dibenzofuran | NA | -- | NA | -- |
| | | | Chrysene | NA | -- | NA | -- |
| | | | Fluoranthene | NA | -- | NA | -- |
| | | | Naphthalene | NA | 0.32 | NA | 0.32 |
| | | | Carbazole | NA | -- | NA | -- |
| | | | Pyrene | NA | -- | NA | -- |
| | | | 2-Methylnaphthalene | NA | -- | NA | -- |
| | | | 1,1'-Biphenyl | NA | 0.15 | NA | 0.15 |
| | | | Pentachlorophenol | NA | -- | NA | -- |
| | | | Arsenic | NA | -- | NA | -- |

Table C-3. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk: Ingestion | Noncancer Risk: Inhalation | Noncancer Risk: Dermal | Noncancer Risk: Exposure Routes Total |
|---|---|---|---|---|---|---|---|
| Sol | Surface soil volatiles | Pine Yard | TEQdf | NA | 0.080 | NA | 0.080 |
| | | | Benzo[a]pyrene | NA | NA | NA | NA |
| | | | Benzo[a]anthracene | NA | -- | NA | -- |
| | | | Benzo[b]fluoranthene | NA | NA | NA | NA |
| | | | Benzo[k]fluoranthene | NA | NA | NA | NA |
| | | | Dibenzo[a,h]anthracene | NA | NA | NA | NA |
| | | | Indeno[1,2,3-cd]pyrene | NA | NA | NA | NA |
| | | | Dibenzofuran | NA | -- | NA | -- |
| | | | Chrysene | NA | NA | NA | NA |
| | | | Fluoranthene | NA | -- | NA | -- |
| | | | Naphthalene | NA | 0.000011 | NA | 0.000011 |
| | | | Carbazole | NA | NA | NA | NA |
| | | | Pyrene | NA | -- | NA | -- |
| | | | 2-Methylnaphthalene | NA | -- | NA | -- |
| | | | 1,1'-Biphenyl | NA | 0.000013 | NA | 0.000013 |
| | | | Pentachlorophenol | NA | NA | NA | NA |
| | | | Arsenic | NA | 0.0023 | NA | 0.0023 |
| | | | | | | Soil HI total = | 10 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quantitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-4. Risk Characterization Summary - Cancer

Scenario Timeframe: Future
Receptor Population: Indoor Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Carcinogenic Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface Soil | Pine Yard | TEQdf | 1.3E-04 | NA | NA | 1.3E-04 |
| | | | Benzo[a]pyrene | 7.9E-06 | NA | NA | 7.9E-06 |
| | | | Benzo[a]anthracene | 1.9E-06 | NA | NA | 1.9E-06 |
| | | | Benzo[b]fluoranthene | 1.2E-06 | NA | NA | 1.2E-06 |
| | | | Dibenzo[a,h]anthracen | 1.2E-06 | NA | NA | 1.2E-06 |
| | | | Pentachlorophenol | 2.1E-06 | NA | NA | 2.1E-06 |
| | | | Arsenic | 7.1E-06 | NA | NA | 7.1E-06 |
| | | | | | | Soil risk total = | 2E-04 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-5. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Indoor Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface Soil | Pine Yard | TEQdf | 4.2 | NA | NA | 4.2 |
| | | | Benzo[a]pyrene | 0.074 | NA | NA | 0.074 |
| | | | Benzo[a]anthracene | -- | NA | NA | -- |
| | | | Benzo[b]fluoranthene | -- | NA | NA | -- |
| | | | Dibenzo[a,h]anthracen | -- | NA | NA | -- |
| | | | Pentachlorophenol | 0.0029 | NA | NA | 0.0029 |
| | | | Arsenic | 0.044 | NA | NA | 0.044 |
| | | | | | | Soil HI total = | 4 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quantitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor.

Table C-6. Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Population: Outdoor Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Carcinogenic Risk: Ingestion | Inhalation | Dermal | Exposure Routes Total |
|---|---|---|---|---|---|---|---|
| Soil | Surface Soil | Pine Yard | TEQdf | 2.4E-04 | NA | 3.1E-05 | 2.7E-04 |
| | | | Benzo[a]pyrene | 1.4E-05 | NA | 7.9E-06 | 2.2E-05 |
| | | | Benzo[a]anthracene | 3.4E-06 | NA | 2.0E-06 | 5.4E-06 |
| | | | Benzo[b]fluoranthene | 2.2E-06 | NA | 1.2E-06 | 3.4E-06 |
| | | | Dibenzo[a,h]anthracene | 2.2E-06 | NA | 1.2E-06 | 3.4E-06 |
| | | | Pentachlorophenol | 3.7E-06 | NA | 3.9E-06 | 7.6E-06 |
| | | | Arsenic | 1.3E-05 | NA | 2.7E-06 | 1.6E-05 |
| | | | Naphthalene | 1.6E-06 | NA | 8.9E-07 | 2.5E-06 |
| | Surface soil particulates | Pine Yard | TEQdf | NA | 1.3E-08 | NA | 1.3E-08 |
| | | | Benzo[a]pyrene | NA | 1.6E-09 | NA | 1.6E-09 |
| | | | Benzo[a]anthracene | NA | 3.9E-10 | NA | 3.9E-10 |
| | | | Benzo[b]fluoranthene | NA | 2.5E-10 | NA | 2.5E-10 |
| | | | Dibenzo[a,h]anthracene | NA | 2.5E-10 | NA | 2.5E-10 |
| | | | Pentachlorophenol | NA | 8.9E-12 | NA | 8.9E-12 |
| | | | Arsenic | NA | 1.1E-08 | NA | 1.1E-08 |
| | | | Naphthalene | NA | 8.6E-11 | NA | 8.6E-11 |
| | Surface soil volatiles | Pine Yard | TEQdf | NA | 9.3E-06 | NA | 9.3E-06 |
| | | | Benzo[a]pyrene | NA | NA | NA | NA |
| | | | Benzo[a]anthracene | NA | 1.2E-07 | NA | 1.2E-07 |
| | | | Benzo[b]fluoranthene | NA | NA | NA | NA |
| | | | Dibenzo[a,h]anthracene | NA | NA | NA | NA |
| | | | Pentachlorophenol | NA | NA | NA | NA |
| | | | Arsenic | NA | NA | NA | NA |
| | | | Naphthalene | NA | 2.5E-06 | NA | 2.5E-06 |
| | | | | | | Soil risk total = | 3E-04 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quantitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-7. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Outdoor Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk: Ingestion | Inhalation | Dermal | Exposure Routes Total |
|---|---|---|---|---|---|---|---|
| Soil | Surface Soil | Pine Yard | TEQdf | 7.5 | NA | 0.95 | 8.4 |
| | | | Benzo[a]pyrene | 0.13 | NA | 0.073 | 0.21 |
| | | | Benzo[a]anthracene | -- | NA | -- | -- |
| | | | Benzo[b]fluoranthene | -- | NA | -- | -- |
| | | | Dibenzo[a,h]anthracene | -- | NA | -- | -- |
| | | | Pentachlorophenol | 0.0052 | NA | 0.0055 | 0.011 |
| | | | Arsenic | 0.079 | NA | 0.017 | 0.096 |
| | | | Naphthalene | 0.0019 | NA | 0.001 | 0.0029 |
| | Surface soil particulates | Pine Yard | TEQdf | NA | 0.000025 | NA | 0.000025 |
| | | | Benzo[a]pyrene | NA | 0.0038 | NA | 0.0038 |
| | | | Benzo[a]anthracene | NA | -- | NA | -- |
| | | | Benzo[b]fluoranthene | NA | -- | NA | -- |
| | | | e | NA | -- | NA | -- |
| | | | Pentachlorophenol | NA | -- | NA | -- |
| | | | Arsenic | NA | 0.00050 | NA | 0.00050 |
| | | | Naphthalene | NA | 0.0000024 | NA | 0.0000024 |
| | Surface soil volatiles | Pine Yard | TEQdf | NA | 0.017 | NA | 0.017 |
| | | | Benzo[a]pyrene | NA | NA | NA | NA |
| | | | Benzo[a]anthracene | NA | -- | NA | -- |
| | | | Benzo[b]fluoranthene | NA | NA | NA | NA |
| | | | Dibenzo[a,h]anthracene | NA | NA | NA | NA |
| | | | Pentachlorophenol | NA | NA | NA | NA |
| | | | Arsenic | NA | NA | NA | NA |
| | | | Naphthalene | NA | 0.069 | NA | 0.069 |
| | | | | | | Soil HI total = | 9 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quantitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-8. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface Soil | Pine Yard | TEQdf | 27 | NA | 2.6 | 30 |
| | | | Benzo[a]pyrene | 0.49 | NA | 0.20 | 0.69 |
| | Surface soil particulates | Pine Yard | TEQdf | NA | 0.0094 | NA | 0.0094 |
| | | | Benzo[a]pyrene | NA | 1.4 | NA | 1.4 |
| | Surface soil volatiles | Pine Yard | TEQdf | NA | 0.019 | NA | 0.019 |
| | | | Benzo[a]pyrene | NA | -- | NA | -- |
| | | | | | | Soil HI total = | 30 |

Notes:

Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.
-- = Toxicity criteria are not available to quanitatively address this route of exposure.
NA = Route of exposure is not applicable for this receptor for this COPC.

Table C-9. Risk Characterization Summary - Noncancer

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adolescent

| Medium | Exposure Medium | Exposure Point | Chemical of Concern | Noncancer Risk | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ingestion | Inhalation | Dermal | Exposure Routes Total |
| Soil | Surface Soil | Pine Yard | TEQdf | 3.1 | NA | 0.25 | 3.4 |
| | | | | | | Soil HI total = | 3 |

Notes:
Consistent with USEPA guidance cumulative risks and noncancer hazards are shown to one significant figure.

# APPENDIX D

## PROPOSED REMEDIATION WASTE DESIGNATION APPROACH FOR KERR-MCGEE CHEMICAL CORP. SUPERFUND SITE—COLUMBUS, MS

**Proposed Remediation Waste Designation Approach for Kerr-McGee Chemical Corp. Superfund Site – Columbus, MS**
**Greenfield Environmental Multistate Trust, LLC,**
**Trustee of the Multistate Environmental Response Trust**
**May 11, 2018**

Subject to EPA's concurrence, remediation waste generated by the Multistate Trust during the performance of Environmental Actions at the Columbus Site (the "Site") will be designated as hazardous (listed or characteristic) as follows:

1. Pine Yard & Former Plant Site (Excluding Drip Track): Remediation waste generated by Environmental Actions in the Pine Yard and general areas of the Former Plant Site (with the exception of the drip track as noted in Item 2 below) will be designated as hazardous waste based on characteristics determined by representative sampling.
    a. Relevant EPA Guidance: EPA's guidance entitled Management of Remediation Waste Under RCRA (USEPA 1998) states "Where a facility owner/operator makes a good faith effort to determine if a material is a listed hazardous waste but cannot make such a determination because documentation regarding the source of contamination, contaminant or waste is unavailable or inconclusive, EPA has stated that one may assume the source contaminant or waste is not listed hazardous waste…".
    b. Good-Faith Determination Based on Document Review: Documentation reviewed by the Multistate Trust about historic operations at the Site includes waste manifests, annual waste reports, site maps and aerial photographs. These documents confirm that listed wastes were managed in the past as part of active Site operations, but documentation reviewed to date by the Multistate Trust does not provide specific details about the source, times or locations of releases of creosote or pentachlorophenol constituents to the environment at the Pine Yard or general Former Plant Site. While anecdotal information suggests there may have been wood treating operations in the Pine Yard, the Multistate Trust is not currently aware of corroborating documentation of specific wood treating activities, storage practices and/or timeframes. Therefore, documentation regarding the time of a release to the environment at these areas of the Site and the source of contamination is unavailable or inconclusive. Based on the foregoing, the Multistate Trust will assume that the source contaminant or waste at the Pine Yard and the general Former Plant Site is not listed waste. In consultation with EPA, the Multistate Trust will perform representative sampling to assess whether the non-listed waste

in the Pine Yard and general Former Plant Site (excluding the Drip Track) should be determined hazardous based on characteristics.

2. <u>Drip Track Area of Site</u>: Remediation waste from the drip track area of the Former Plant Site will be designated as a FO34 listed hazardous waste. EPA's definition of a F034 specifically includes drippage: "F034 - Wastewaters (except those that have not come in contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations." The Multistate Trust has reviewed documentation that identifies the drip track as a source or location of releases. In addition, the purpose and use of the drip track is to allow the listed waste to drip off the treated material and onto the surface below.